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REVIVAL IN EXPORT TRADE.

The figures issued by the Bureau of Statistics in the Department of Commerce and Labor bear out the view expressed frequently in these columns that the shrinkage in American manufactured exports was but one demonstration of universal trade shrinkage after the boom period up to 1907; and that returning good times would begin to see an approach to the old levels. The Bureau has just published an interesting analysis which shows "that the United States contributed in 1908, in fact, a larger percentage of the imports of the principal foreign countries of the world than in the earlier years when our export trade was at its maximum." This is, to say the least, an interesting and encouraging fact.

Turning to the specific figures just published for the month of September, it would appear that in certain branches of electrical export trade there is distinct improvement; while others are slow in emerging from depression. The export of electrical instruments and apparatus this September reached the respectable total of $686,049 as compared with $430,785 a year ago. This is really a notable gain, and if the rate is maintained 1906-7 will soon be left behind. The revival is not so marked in electrical machinery, but even there the sales abroad were $480,835 as compared with $568,525, indicative of growing taste and absorption for heavy apparatus in foreign countries that had nearly stopped buying at all. The total for this September is therefore $1,166,884 as compared with $999,310 in 1908, an increase of $167,574, a gain of nearly 15 per cent. Such data justify optimism, not only as to American electrical conditions, but as to those of the world at large.

Some foreign countries are taking a large proportion of the increase, British North America raising its purchases of instruments from $99,857 to $200,336, Brazil from $83,026 to $151,166, and Mexico from $34,427 to $90,471. There are no notable gains in heavy machinery, but British Australasia was virtually an exception in this respect by increasing from $11,977 to $68,065. There are also slight gains in both departments for the United Kingdom, an aspect of affairs all must view with pleasure in the hope that behind it lies a marked revival of British industry and foreign trade.

THE LIGHT OF THE FIRE FLY.

The communication from Dr. Coblentz elsewhere in our columns is a most interesting contribution to the question of the fire fly's secret, apropos of Dr. Ives' paper before the recent Illuminating Engineering Society's convention. It is particularly instructive as impressing upon the reader the extreme difficulty of making radiometric measurements of the invisible radiation of the fire fly. From what Dr. Coblentz says, not only is the repetition of Langley's work, which we believe to be very instructive, highly desirable, but it seems somewhat doubtful whether the negative evidence obtained by Langley could really have been very conclusive. Dr. Coblentz suggests that the important thing is a hunt for radiation in the nearer part

of the infra-red rather than in the longer waves chiefly considered by Langley. As a preliminary step it would be very desirable to follow up Dr. Ives' experiments by work with photographic plates peculiarly sensitive to the extreme red and the nearer infra-red—such plates, for example, as were used by Abney in his infra-red researches. For, while Dr. Ives' experiments, already published, seem to make it perfectly clear that the spectrum of the fire fly's light is not merely not one of low intensity, it is still a little uncertain whether the radiation might not be materially further extended by the use of different plates from those he employed. At all events, the matter should be settled one way or the other.

A very interesting suggestion of Mr. Coblentz, and one which deserves close investigation, is the kinship of the radiation apparently given by the fire fly with some of the fluorescent spectra. The suggestion of a step-down process of radiation is certainly novel, but in matters involving physiological chemistry nothing is so extraordinary as to be improbable, and the possibility of such indirect type of radiation is at least worth considering. Certainly the fire fly should not be allowed to glow uninvestigated, for it is of considerable practical moment to find out whether the type of radiation it emits is really as efficient as its character suggests, or upon the whole perhaps inefficient, as Dr. Ives seems to think possible. If it should be shown that even by thoroughly indirect means it is possible by processes of physiological chemistry to obtain highly efficient radiation, then a new field of possible application is open; while if, on the other hand, investigation of the operation should show intrinsic inefficiency, progress along this particular line would seem to be far less likely. Fluorescent phenomena as such appear to be somewhat unpromising, since the very short radiations which are most effective in exciting fluorescence are not the ones the transformation of which is to be desired in producing light, since the energy waste of our present methods is in the existence of long rays and not the abnormal production of short ones. It will be interesting to know, however, at what efficiency the transformation downward by fluorescence takes place. Whether the fire fly is an example of such transformation is another matter, but assuredly the little being in all his varieties is well worth continued investigation.

The Design, Cost and Efficiency of Modern Electrical Machinery.

In this country, dynamo-electric machinery tends to become standardized in dimensions, cost and behavior by reason of its manufacture being largely confined to a very few large corporations; but even in Europe, where the manufacture is divided among a large number of firms, the tendency is toward a standard average of dimensions, cost and performance, owing to the influences of competition. An article on this subject by Mr. L. Grouch, in the London *Electrical Review*, abstracted in the Digest, presents a large number of facts concerning British dynamo-electric machinery in a readily assimilable graphical form. Naturally, the actual purchasing costs of British machinery cannot be directly compared with our own, but direct comparisons may advantageously be made between British and American machine designs and performances. It appears, from the diagrams illustrating the article, that motors of between 20 hp and 140 hp average in weight about 50 lb. per horse-power (21 kg. per horse-power), or give a rated power of 15 watts per pound of weight (33 watts per kilogram). Alternating-current generators come heavier, having to maintain a considerable reserve of structural strength and of voltage regulation. Up to 300 kw, they are indicated as weighing about 110 lb. per kilowatt (50 kg. per kilowatt); or as delivery, at rated load, about 9 watts per pound (20 watts per kilogram). Of course, a 300-kw generator is at the present time only a diminutive machine, by comparison with central-station generators in which the specific power delivery is greater.

In regard to speeds, direct-current motors are indicated as having distinctly lower speeds than alternating-current motors up to 120 hp. Above that output, the latter motors appear to run the more slowly. The alternating-current motors are also more expensive than the direct-current type, except in small sizes, perhaps on account of the finer machine work demanded in good polyphase construction. Attention is called in the article to the rapid reduction in purchase cost per horse-power in motors above the small sizes. This condition necessarily applies in all countries, and makes it desirable to use one large motor, instead of many small ones, where the duty is capable of being assumed by a single unit. A noteworthy feature of motor construction in Great Britain is ball bearings in motors up to 40-hp output. This is a standard construction that with us is not the most usual. It has the effect of reducing friction losses in small machines and thus of raising the efficiency. In regard to efficiency, power factor and slip, the conditions appear to resemble fairly well those that pertain here. Efficiency is not wholly a matter of purchasing cost. By improving the efficiency, and reducing internal losses to a reasonable extent, the manufacturer can increase to some extent the output and value of his machine, so that, apart from competitive influence, machine efficiencies tend to parallel themselves in different factories. The article concludes by pointing out that the high efficiency and moderate cost of modern electrical machinery have given the latter a unique position in modern engineering and factory practice.

Italian Report on 1908 Conference on Electrical Units.

The Italian report to the Minister of Agriculture, Industry and Commerce of Italy has now been printed on the conference of Government delegates, which met in London last October to discuss international electrical units. The burden of the report appears to be the explanation and justification of the "two zeros." The conference of October, 1908, has been called the "Two-Zeros Conference," because it defined the mercurial length of the international ohm as 106.300 cm and the electrochemical equivalent of the ampere, in silver, as 1.11800 milligrammes per second. Such a numerical procedure is always suspicious from a physicist's point of view, because two such final zeros are supposed to cover sins of omission; and no one believes that the international precision of measurement is really so great at present as these numbers would indicate. It seems that the principal reason for adding the two zeros in each case was to indicate that, whatever the last two digits might actually be, they were probably not very far numerically from two zeros, and that it would be better for the sake of international uniformity to keep to two zeros, even if measurements in the near future should indicate that other final digits were more probable. If this is a correct statement of the situation, the condi-

tions might have been better defined in language than by offending the numerical sense. That is, it might have been better to lop off the superfluous zeros in the specifications, and to state that for the present no higher degree of numerical precision was expedient to be formulated. However, so long as the reason for the existence of the two zeros is clearly discernible, they will make their own apologies to the wondering physicist.

REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON ELECTRICAL STANDARDS.

The report of the British Association committee on practical standards for electrical measurements, presented at the Winnipeg convention, has recently been published, in abstract, by the London *Electrician*. The abstract contains some interesting tables of comparative measurements at the national physical laboratories of England, Germany and the United States of a set of eight standard resistance coils belonging to the Bureau of Standards. These coils were passed from one laboratory to another, so that the comparative measurements were all made within a few months. As might be expected, the measurements are in close agreement. There are 44 measurements recorded in all, and the largest discrepancy is 0.0029 per cent. The average discrepancy is about 0.002 per cent. According to the report, then, this is about the degree of precision which is attainable in the measurement of resistance standards, at the present time, as between different national laboratories. The precision of measurement in one and the same laboratory, by the same observer, would, of course, be greater. The discrepancies between the measurements of a resistance coil at different laboratories include more than mere discrepancies in resistance. They include discrepancies in local resistance standards and discrepancies in temperature observation. It is noted that one coil after being measured in England and shipped to Germany returned to England with an increase of 0.001 per cent. This means that a change of 0.001 per cent was looked upon as unexplainable by errors of observation. In some careful industrial measurements of resistance, a precision of 0.01 per cent is aimed at, and frequently secured, so far as concerns errors of observation, so that the national laboratories are one order of magnitude in precision. This is satisfactory, but by no means too good. At least one order of magnitude should be preserved, if possible, in our *lares* and *penates* at national laboratories over those preserved in industrial practice at our factories.

THE FIELD FOR THE TURBO-GENERATOR.

The 5000-kw exhaust steam turbo-generator recently installed in the subway power house of the Interborough Rapid Transit Company is a capital example of putting the steam turbine to its very best use. There is still some doubt as to the apparatus best adapted to obtain the maximum efficiency of utilization from steam; but there is none whatever when it comes to working below atmospheric pressure. The relatively very high speed of the turbine is a blessing when it comes to low pressures, for it enables good output to be obtained in a machine of moderate cost and size subject to the minimum radiation losses. More than this, its friction is also very low, while that of a very low-pressure reciprocating engine is inconveniently high compared with the output obtained. On the other hand, at high pressure and superheat, the reciprocating engine is as yet unbeaten. While some of the big multi-stage, turbo-generators have done very remarkably well in the matter of economy, the record performances are not yet theirs, and perhaps never will be. Unless American builders take a brace, however, in the use of superheaters, the turbine may yet occupy the whole field to the exclusion of the older engine in all important plants.

Anyone who has built power plants fully realizes the dead level to which a stolid complacency in standardization has reduced most builders of reciprocating engines. With very few exceptions they have thus far refused to make use of modern improvements and have contented themselves with 100 deg. or so of superheating, steadfastly refusing to accommodate their designs to anything better. The result is that the turbine makers, more progressive from the very novelty of their work, are rapidly pushing ahead and beating out plants that they could not compete with save through the lack of enterprise of their rivals. While five-stage turbines are common, triple-expansion engines are scarce in power plants. An ordinary compound engine is not in competition with a multi-stage turbine, and engineers unmindful of the uniform loads to be had in a great modern power station have been unduly cautious in going to triple expansion. Perhaps one should not be ungrateful for this on the ground that by this negligence the turbine has been enabled to make more rapid progress, so that on the whole the art may have advanced. Certain it is, that the turbine is making wonderful progress all along the line, especially in marine work.

The turbine's best hold, however, just now seems to be in the utilization of exhaust steam as in the Interborough plant we are considering. The very fact that many very important reciprocating engine plants are inefficiently organized as respects high expansion gives the turbine a magnificent opportunity. What would be the ultimate economy of a plant like this one plus its low-pressure turbine as compared with a first-class pure turbine plant or a modern reciprocating engine plant at high superheat, does not for the moment matter. One has to deal with things as they are, and the fact is that a good compound condensing plant can be made much better by what amounts to triple compounding by means of a low-pressure turbine. The linking is not quite so direct as in ordinary triple-expansion practice; but perhaps the very flexibility of the connection is a material advantage once the governing problem is satisfactorily dealt with. The gain in space, too, is highly advantageous especially in a plant well crowded with machinery, so that really there is everything to gain and nothing to lose in adding the turbine. As to the absolute economy of the combination, few reliable data are at hand, particularly on a large scale, but that the results will be good there is no reason to doubt. It is not at all unlikely that we shall see large new composite plants built presently, although there is enough work on the older ones to keep the turbine builders busy for a long time to come. In the course of the next year, we shall hope to have full reports from the performance of this Interborough plant, reports detailed enough to form a complete basis for future practice. Meanwhile, its engineers are to be congratulated on their enterprise in installing an exhaust plant in such a thorough manner and on so large a scale as to give a proper criterion of its value.

Patent Office Permitted to Investigate Irregularities.

Justice Shepard, of the District of Columbia Court of Appeals, has decided that courts are invested with no power to interfere with or to supervise the conduct of investigation in the Patent Office. The decision reversed a decree of the lower court in an injunction granted John A. Heany, of the Heany Lamp Company, prohibiting Commissioner Moore, of the Patent Office, from prosecuting an investigation into alleged irregularities in applications for Heany's patents. The case grew from the criminal prosecution in connection with tungsten-lamp patents, which resulted in penitentiary sentences for Attorney Henry E. Everding, of Philadelphia, and Patent Examiner Ned W. Barton. From the facts brought out at the trial, Commissioner Moore decided to investigate the applications for the Heany patents on the use of tungsten as a filament. Heany thereupon obtained the injunction which has just been reversed.

A Comprehensive Report from Chicago Traction Engineers.

The first annual report of the Board of Supervising Engineers, Chicago Traction, has made its appearance. It covers the year from Feb. 1, 1907, to Jan. 31, 1908, its publication having been delayed for various reasons. The report makes a volume of 462 pages, and is carefully prepared, detailed and comprehensive—a worthy installment of the complete report of the great undertaking of rehabilitating the street-railway systems in Chicago. In eight chapters the history of street-railway service is given, followed by an account of the organization and work of the Board of Supervising Engineers, which consists of Mr. Bion J. Arnold, chairman; Mr. George Weston, representing the city of Chicago; Mr. Harvey B. Fleming, representing the Chicago City Railway Company, and Mr. John Z. Murphy, representing the Chicago Railways Company. The work described is that of rebuilding a modern and complete system of street railways at an expenditure, when completed at the end of the three-year rehabilitation periods, of approximately $43,000,000, divided into $17,000,000 for the Chicago City Railway Company and $26,000,000 for the Chicago Railways Company. The three-year period will expire April 15, 1910, in the case of the Chicago City Railway Company and Jan. 28, 1911, for the Chicago Railways Company. Much of the information contained in the book has already appeared in the technical press, but the volume contains a wealth of detail and statistical information which, with its successors, will make it valuable. It is said that the second volume of the report will soon be published.

Brailey Independent Telephone Situation.

Legal actions of various kinds are following the recent change in the independent telephone situation in Ohio. By some it is thought that these moves are the preliminary steps to force the new owners of the Cuyahoga Telephone Company and the United States Telephone Company to come to the front. Others state that they do not understand the motives of those who are instrumental in bringing legal proceedings.

Following the institution of a suit against the Toledo Home Telephone Company, by Herman C. Stifel, of St. Louis, to compel the company to permit an inspection of its books, he has been served with papers in a suit instituted by the company to collect on a promissory note for $7,000 which, it is claimed, was given on Nov. 12, 1908, for stock. The note was signed by Max Koehler and Mr. Stifel and was to run for six months. It is alleged that no payments have been made on the note and an attachment on the stock and other securities which Mr. Stifel left in possession of the company.

Daugherty, Todd & Rarey, of Columbus, Ohio; McGraw, Hauxhurst & Saeger, of Cleveland, and C. A. Seiders, of Toledo, are the legal firms employed by Mr. Stifel to conduct his suit at Toledo. Harry M. Daugherty, who has been active in independent telephone matters for a number of years, seems to be directing the proceedings. It is said that some of Mr. Brailey's friends admit that Mr. Stifel has a right, as a director and stockholder of the company, to inspect the books, but that he will not be allowed to do so just yet. They believe that Mr. Stifel has an idea that some of the securities of the company were put up to secure money for the purchase of stock in the Cuyahoga and United States Telephone companies, but they say this is not true. Further, it is said that he sold some of his holdings, but that he had a perfect right to do that, as any other stockholder may do the same thing.

The National Telephone Company, of Wheeling, W. Va., on Nov. 6, filed suit in the United States Circuit Court, at Cleveland, against the United States Telephone Company, asking that a contract for the sale of the Youngstown Telephone Company, the Columbiana County Telephone Company and some other systems and lines be enforced. An injunction is also asked to prevent the disposal of the properties and the appointment of a receiver to take charge of the long-distance lines pending a decision. The National Telephone Company alleges that on June 18 last it entered into a contract with the United States Telephone Company to purchase $200,000 of the common stock and $69,000 par value of the preferred stock of the Youngstown Telephone Company; all but five shares of the outstanding stock of the Columbiana County Telephone Company, which amounts to $300,000 par value; a half interest in the United States Telephone line between Youngstown and Sharon, Pa.; all lines from and into Youngstown to Sharon; the Youngstown-Pittsburgh line from Youngstown to the Ohio State line; the line from Sharon to Wellsville and the line between Wellsville and Steubenville. In return the National Telephone Company was to deliver 2700 shares of its stock to the United States Telephone Company on July 1 and was to reconstruct the Youngstown exchange and the Columbiana County system and do certain other things mentioned in the contract. It is claimed that the stock was tendered to the United States Telephone Company on Oct. 30, but that it was refused and the company refused also to turn over the properties claimed or to recognize the alleged contract.

Mr. E. G. Tillotson, chairman of the board of the United States Telephone Company, and Mr. W. L. Carey, secretary, state that negotiations were under way for a time and that the National Telephone Company failed to comply with the terms offered, so the matter was dropped. They say there is nothing in the suit and that the company can gain nothing by this action.

There are indications that this is part of the Stifel proceedings, but this is only a surmise, as nothing definite is known of it beyond the fact that McGraw, Hauxhurst & Saeger acted as attorneys for the National Telephone Company in this suit and that John A. Howard, head of the National, is associated with Mr. Stifel in the syndicate which is promoting the Continental Telephone & Telegraph Company.

Court Definition of Annual Horse-Power.

The interesting case at Niagara Falls recently noted in these columns, covering the point whether the Canadian Niagara Power Company should pay rental for water used in the generation of power at the maximum demand or simply upon the average amount used throughout the year, was decided on Nov. 1 in favor of the company, the court dismissing the action brought by the Attorney-General on behalf of the Queen Victoria Niagara Falls Commission, which made the lease to the company. The judgment covered 74 pages, and the effect of the decision is that the power company must pay, not at the rate of the maximum amount taken on any day, but for the actual power taken during the whole term. The amount of excess power rental sued for was $15,217.97.

Annual Report of the Commonwealth Edison Company.

At a special meeting of the stockholders of the Commonwealth Edison Company, Chicago, held Nov. 8, the company's capital stock was increased from $30,000,000 to $40,000,000, as recommended by the directors some time ago. The special meeting was preceded by the regular annual meeting of the company, at which President Samuel Insull presented his annual report for the fiscal year ended Sept. 30, 1909. This report shows that the business of the company is in a highly prosperous condition, the net earnings available for dividends, after paying interest on bonds and debentures and setting aside a depreciation reserve, being $2,386,996, or 7.95 per cent on the capital stock of the company. The net earnings reported a year ago were $1,857,704. The dividends paid during the year were at the rate of 6 per cent, leaving a balance carried to surplus of $586,996.

The following is a condensed statement of the earnings and expenses for the fiscal year, as well as assets and liabilities:

Business Summary.		
Gross income from electric current and merchandise sales		$10,639,446.50
Operating, repairs and renewals, depreciation, taxes and general expense		6,642,693.67
Net income from all sources		$3,996,752.83
CHARGES AGAINST INCOME.		
Interest on bonds and debentures	$1,182,506.63	
Depreciation reserve under the terms of the mortgages made by the Chicago Edison Company and the Commonwealth Electric Company	427,250.00	
Dividends paid	1,800,000.00	
		$3,409,756.63
Balance		$586,996.20
Assets.		
Plants, real estate, etc		$57,105,744.41
Unfinished plant investment		99,377.92
Open accounts		180,183.71
Material in store-rooms		793,777.05
Coal in storage		92,107.50
Accounts and bills receivable		1,287,464.02
Cash		1,026,329.76
		$60,584,984.37
Liabilities.		
Capital stock		$30,000,000.00
Bonds		24,662,000.00
Real estate mortgages		130,000.00
Depreciation reserve		2,221,750.00
Accounts payable		783,519.47
Municipal compensation		122,468.19
Bond interest accrued		224,042.46
Taxes accrued		411,387.55
Surplus account		2,029,816.70
		$60,584,984.37

During the fiscal year the directors of the company issued and sold $11,250,000 of the company's 5 per cent bonds, and paid off obligations amounting to $7,921,000. The obligations retired were: $500,000 of Commonwealth Electric Company 5 per cent debentures; $588,000 Chicago Edison Company 5 per cent first-mortgage gold bonds; $1,483,000 Chicago Edison Company 6 per cent debenture bonds; $5,000,000 Chicago Edison Company 5 per cent three-year gold debentures; $200,000 Chicago Sectional Electric Underground Company first-mortgage bonds, and $90,000 in real-estate mortgages.

The report shows that the company has four generating stations and 35 substations. This does not include the substations of railway companies to which electrical energy is supplied by the Commonwealth Edison Company "in bulk" at wholesale rates. The company's connected business (exclusive of electrical energy supplied to other public-service corporations) amounted to the equivalent of 4,920,800 standard 16-cp lamps Sept. 30, 1909. On Sept. 30, 1908, this figure was 4,137,650, a gain of 783,150 16-cp equivalents during the year.

The stockholders have authorized the directors to issue the $10,000,000 of new stock from time to time as the directors may deem advisable. It is probable that $3,000,000 of this new stock will be offered to the stockholders at par in February next. The board of directors consists of Messrs. Henry A. Blair, Edward L. Brewster, Benjamin Carpenter, Joseph Leiter, Robert T. Lincoln, John J. Mitchell, Erskine M. Phelps, A. A. Sprague and Samuel Insull. The executive committee consists of Messrs. Brewster, Sprague, Lincoln, Mitchell and Insull.

Statistics of Chicago Central Stations.

The first meeting of the season of the Lewis Institute Branch (Chicago) of the American Institute of Electrical Engineers, on Nov. 3, was attended by nearly 400 students. The speaker of the evening, Mr. Alex. D. Bailey, of the Commonwealth Edison Company, gave an interesting talk on central-station operation in Chicago. The Fisk Street and Quarry Street stations were cited as examples of the most modern central-station practice. The boiler-rooms of these two adjacent stations contain 104 boilers, with a total heating surface of nearly 14 acres, capable of evaporating over 2,500,000 lb. of water an hour and converting it into steam at 200 lb. pressure and 150 deg. superheat. This requires nearly 50 carloads of coal a day. The turbine-rooms contain 13 turbo-generators of a total rating of 162,000 kw. The current is generated at 9000 volts. The operation of the switches is carried on from operating galleries in the turbine-rooms with the remote-control system. Therefore, no pressure exists on the operating board over 110 volts.

Cleveland Electrical League.

The Electrical League of Cleveland held its first lunch at the Gillsy Hotel, Saturday, Oct. 30. About 95 members were present, and the occasion was one of much enthusiasm and interest. Mr. W. R. Warner, president of the Warner & Swasey Company, gave an interesting talk on methods of determining latitude in the polar regions. This club is the outcome of a "Harmony" luncheon given two weeks ago as a preliminary step toward bringing the electrical men in Cleveland into closer touch and promoting harmony and co-operation. For the present the organization will be simply a lunch club, but later on it is hoped that a closer organization will be perfected.

Peat as Fuel.

The use of peat as a factor in the production of electricity has again been brought to attention as a result of certain experiments recently made by the Dominion Government. The Department of Mines has been engaged upon a series of tests under the direction of the superintendent, Dr. Haanel, in the expectation that the results hoped to be achieved would warrant the use of peat in gas-producer plants as a means of generating electric current, which could then be transmitted in the same manner as electricity is now transmitted from water-power and steam-generating plants.

After extensive investigations into the methods pursued in other countries, the department procured a bog of about 300 acres, at Alfred, some distance east of Ottawa on the Canadian Pacific Railroad. The peat here is of good quality nd 8 ft. or 9 ft. thick. Extensive works have been installed, and the manufacture of peat fuel by the air-dried process has been successfully established.

Among the favorable points to be noted with regard to this method are the cheapness and economy of the plant. There is a minimum of apparatus, and as the peat is used the plant follows it. By next year the sale of peat will begin. It is hoped that the plant will be able to sell the fuel at $2.25 a ton. As 1 8/10 of peat fuel are equivalent to one ton of the best coal, the saving is quite apparent.

The fuel is expected to be of great value for domestic purposes, for which it is understood to be well suited, particularly if it can take the place of the imported anthracite, which sells locally at $7.50 per ton. Favorable results are also expected from the fuel if it can be extensively used in gas-producer plants, which will have the effect of causing large generating stations to be erected in the vicinity of the numerous peat bogs all over the country and make the peat field rivals of the water-powers as an efficient and economical means of generating electrical energy.

Electric Fire Protection on Governor's Island, New York.

Governor's Island, New York, the headquarters of the Atlantic Division of the United States Army and the Department of the East, has a population of about 400, exclusive of the military prisoners confined in Castle William. Until three or four years ago, strange as it may seem, this community, within a stone's throw of the metropolis of the Western Hemisphere, possessed no modern system of illumination, and was lighted exclusively by kerosene oil. About the time mentioned the Government laid a cable from Brooklyn to Governor's Island, and contracted with the Brooklyn Edison Company to supply electrical energy to the reservation. High-tension current is supplied to the cable on the Brooklyn side, and this is transformed and distributed from a rotary station on the island. Every building is wired, and the entire island, including the streets, is now lighted exclusively by electricity.

The means hitherto used for fire protection have been humorously primitive. In cases of conflagration water had to be supplied by the engine of the little ferryboat which plies between the island and the ferry landing in Manhattan. If a fire broke out while this boat was on its way to Manhattan, there was nothing to do but wait for its return to the island. Early in October a fire occurred while the boat was away from its island mooring, and considerable damage resulted before the flames could be extinguished. It was, therefore, proposed by the authorities at Washington to install a modern high-pressure pumping plant, and work on the installation is now under way. This plant consists of an electric motor connected to a 6-in., three-stage turbine pump, capable of throwing a 4-in. stream.

Electricity at the Boston 1915 Exhibition.

A somewhat unusual commercial-sociological exhibition is being held this month at the old Museum of Fine Arts Building, in Copley Square, Boston, with the object of stimulating public interest in the general welfare of the community and setting in motion reform movements which shall have reached a large fruition by 1915. The exhibition is conspicuous by the absence of commodities displayed for sale, and noteworthy on account of the space given to extended plans of urban improvement, philanthropic organizations, transportation, communication, industrial welfare work, religious and scientific activities. A number of the exhibits are dependent upon electricity for their operation or success, including the work of the local street railways, models of workingmen's homes, exhibition of new signal equipment, display of laboratory methods of work in connection with public water supplies, and the influence of the telephone upon the welfare of the community.

The Boston Elevated Railway Company is exhibiting numerous photographs of its system and the historic points reached by its lines, views of recent construction in Middlesex Fells, plans of the new Cambridge subway, maps of the territory tributary to the different subway and elevated lines and models in cardboard of the station to be built in Harvard Square and the existing tunnel station at Essex Street, Boston. The company is also showing a map of Boston in 1775, and wash drawings of Washington Street tunnel stations, entrances, exits and interiors. A number of views of the new construction of the company over the Charles River dam are also shown.

The Boston & Northern and Old Colony Street Railway companies are showing extensive photographs of attractive historic and woodland resorts on their lines, seaside points of interest and recent types of car construction in use by the lines north and south of Boston. The management is also using a reflectoscope in connection with the display of 300 views of the system, which cover over 900 miles of track in Massachusetts, New Hampshire and Rhode Island. Maps and folders are being distributed on a large scale.

The New England Telephone & Telegraph Company has installed a modern central-office exchange switchboard for minute examination by visitors, with several types of private branch equipment in addition. Illuminated signs for electrically advertising telephonic facilities are shown and a small cabinet of moving views of the company's exchanges, with an excellent wall exhibit of telephone fittings old and new, including all the more common forms of transmitters and receivers now in standard service, sections of switchboard cable, complete wiring for a private branch exchange, cable racks, splices, protectors, bells and equipment used in 1878 and in other early years of the art.

The Boston & Albany lines of the New York Central system have an elaborate exhibit of improvements made within the past two or three years, the latest of electrical interest being a new type of signal which is to be installed immediately on the main line. The signal is a product of the Hall Signal Company's shops, and differs from the same make of signals as previously installed on the road in the arrangement of its working parts, all these being carried in a head near the top of the post. The signal is of the semaphore type, and it is motor-operated, with all the parts accessible for replacement with minimum interference with other portions of the mechanism. In the new type, the wiring is carried farther away from the moving parts than in the old form, and greater freedom from interruption is thus assured.

The Edison Electric Illuminating Company of Boston is keeping open house at the exhibition, and has rented a large space where its friends may rest. Complimentary telephone service has been installed, and the company is showing views of its latest power and substation construction, and a map showing the entire system from South Boston to Hopkinton, 43 miles distant.

The Pennsylvania Railroad Company has an elaborate pictorial and model exhibit of its terminal improvements at New York, including a large number of photographs of recent steam and electric locomotives, etc., and a model of the New York and Long Island tunnel, 33 ft. long and 6 ft. deep. The latter model shows a train consisting of an electric locomotive and three cars, and the minute details of the tunnel down to the conduits for power, signaling and lighting cables. There are also photographs of the Washington terminal station, a model of the West Philadelphia freight yard, views of the proposed Hell Gate bridge, the New York City terminal, and many modern types of rolling stock.

The Boston Wire Department is showing numerous photographs of the streets of the city before and after removal of overhead lines, with maps of underground structures and statistical data. During the past 11 years the department has made 244,292 inspections of interior wiring, covering the installations of 6,032,688 lamps; and in the past 15 years 10,821 miles of overhead wire, 5000 roof structures, and 2350 poles have been removed. Three hundred miles of underground conduit have been built. There are now 15,000 poles standing in Boston. Two street miles of conduits are installed yearly at present.

The Massachusetts Institute of Technology has an extensive exhibit of its work in the water supply and sewerage fields, and shows laboratory apparatus for the study of the effects of electrolytic corrosion, electric illumination of chemical color reactions, electric pyrometer measuring to 1000 deg. C., and motor-driven machinery.

The Boston Transit Commission shows a model of the complex station of the Washington Street tunnel at State Street, maps, cross-sections and photographs of the subway and tunnel lines which it has built in the past 10 years.

Edwin C. Lewis exhibited electric lighting, interior wiring and switchboard equipment.

Numerous minor applications of electric lighting are in evidence at the exhibition, including electric flash lamps to attract attenton to charities, miniature lamps showing lighting of suburban farms, on models, signal lamps as used in tuberculosis sanatoria, the talking arc lamp, moving-picture equipment, map of the church distribution of Boston, using different colored

incandescents for the several denominations, and the general illumination of certain exhibit spaces by tungsten lamps.

The Mount Hope Citizens' Association shows drawings of the Forest Hills extension of the Boston Elevated Railway Company, indicating a saving of nine minutes in the time of transit between West Roxbury and the center of Boston by the use of the new elevated line.

The Boston City Hospital has an interesting exhibit of X-ray photographs and views of the treatment of superficial cancer by radium.

Illinois Electrical Exhibitors Association.

At the convention of the Illinois State Electrical Association at Alton, Oct. 26 to 28, an association of supply companies which exhibit at Illinois conventions was formed for the purpose of taking organized action as to entertainment and exhibit features at any future Illinois conventions to which the supply men may be invited. Mr. W. R. Pinckard, of the Westinghouse Electric & Manufacturing Company, who was active in the entertainment of this convention and is a man widely known in the Illinois central-station field for many years, was elected president of the new association, and Mr. W. S. Taussig, of Chicago, was made secretary. The organization is rather informal and the membership will be vested in the men who represent the various supply houses and manufacturing companies.

The organization was publicly announced at the banquet which wound up the convention. At that time the exhibitors presented Assistant Secretary C. A. Willoughby, of the Illinois State Electric Association, with a handsome Elk's pin in recognition of his efforts in getting together by far the largest and most successful convention of the association ever brought together. President Pinckard, of the Exhibitors' Association, made the presentation speech, and incidentally gave the salesmen present some good advice as to future conventions. He told of his special interest in the Illinois association because of his acquaintance with its members for so many years. He stated that the association had not at any previous convention made a formal invitation to make exhibits and provided a place to show them as at this. A continuance of this arrangement would depend on the conduct of the supply contingent.

Boston Electrical Show Nearing Completion.

The Boston Electrical Show, which opens on Monday evening, Nov. 15, for a 10-day run in the Mechanics' Building, is rapidly approaching completion, and bids fair to be one of the most successful exhibitions of its kind ever held in the East. About 100 exhibitors are putting their booths in shape to welcome the public next week and over 50,000 sq. ft. of space will be utilized. The Edison Electric Illuminating Company of Boston will have the largest space in the show, including the large stage in the hall and a considerable amount of space immediately in front. This will be arranged as an Italian garden with a fountain at the main entrance and another in the center of the stage. The passageway leading to the stage will be flanked on either side by palms and plants, water gardens and ornamental flower beds. A grand stairway will be built in Italian style, with colonnade and pergola. In the pergola spaces will be reserved for each of the 33 cities and towns in the Edison territory, which covers 509 square miles at the present time. More than 1,000,000 people occupy this territory, and the company plans to give all a distinctive representation. Personal representatives familiar with each district will be in the pergola spaces or reception parlors, dressed in Italian costume to harmonize with the scheme of the show. When the people call and register, tea will be served. The entire sales department will be present on every night of the show, in evening dress, and will act as escorts for all who visit the show. The company has sent an engraved invitation equivalent to an admission to the show to each of its 35,000 customers. Arrangements have been made for special city and town days, and electric cars will be run from all the suburban towns through to the Mechanics' Building without change. The show will be specially advertised by illuminated floats, which will be run over the Boston trolley lines and the tracks of suburban companies, starting at sundown and running in different directions until midnight on every night for a week preceding the show and on every day of the show. In addition 1,000,000 stickers have been distributed for use on letters and for attachment to parcels and boxes. The suburban sales offices have carried large signs in their windows announcing each day the number of days left before the opening of the show.

Among the novelties which will be exhibited are a model electric home and farm, including a Whiting dairy, where four cows will be milked by electric power at suitable times. A garden space will be set aside for electrically hatched chickens and ducks. An electrically operated laundry and kitchen will also be in service, and the rooms of the residence will be equipped with numerous labor-saving and comfort-insuring devices. Arrangements have been made for high-frequency demonstrations by Mr. Earl L. Ovington, a former pupil of Thomas A. Edison, and for talks on the "Commercial Electric Vehicle" by Mr. Day Baker, addresses by Mr. L. D. Gibbs, of the Boston Edison Company, and by Mr. Leon Bishop, of Boston, the latter on "Wireless Telegraphy." The officers of the exposition are: President, Mr. C. W. Holtzer; vice-president, Mr. A. B. Tenney; secretary, treasurer and general manager, Mr. Chester I. Campbell. Executive committee: Messrs. C. W. Holtzer, A. B. Tenney, C. I. Campbell, W. H. Atkins, G. M. Stuart, Frank J. Stone and Herbert S. Potter.

Water-Power Development on Peshtigo River.

A Chicago financial syndicate has underwritten $1,000,000 of first-mortgage 6 per cent bonds of the Northern Hydroelectric Company, of Green Bay, Wis. This company is developing water-powers on Peshtigo River at High Falls and Johnson Falls, about 54 miles northwest of Green Bay. These falls are about 4½ miles apart, and a 6000-kw plant at High Falls is now more than half completed. It is expected that electrical energy will be transmitted to Green Bay in April of next year. The plant at Johnson Falls will give an output as large as that at High Falls. The dam at the latter site is 40 ft. high and, with its dikes, 4500 ft. long. It will store about 800,000,000 cu. ft. of water. The head at this plant is 85 ft. The generating station contains five 1000-kw units now, and electricity will be transmitted to Green Bay, Marinette and Appleton, where it will be used for local electric light and street-railway service. In addition, the interurban electric railway between Appleton and Kaukauna will be operated by electricity from the Peshtigo River plants. Several large paper mills will also be operated by electricity supplied by the Northern Hydroelectric Company. Mr. Daniel W. Mead, of Madison, Wis., is the consulting engineer for this company.

Mexican Electric Power Projects.

The way in which the Guanajuato mining district has come to the front during the last few years under the influence of cheap electric power is serving as an incentive for a wonderful amount of electric power development in the mineral regions of other parts of Mexico. The latest of these projects has for its field of operations the mining districts situated adjacent to the city of Oaxaca. Large amounts of American capital have been invested in that section during the last four or five years, and in the development of different mining properties the necessity for cheaper power is seen. In order to provide this cheap power, F. Zorrilla, of the city of Oaxaca, and associates will install a hydroelectric plant in the mountains near Etla. The same parties who propose to install this

new plant already own the plant which is supplying Oaxaca with light and power. The present plant is operated by gas engines and is run in conjunction with the hydraulic plant near Etla. The capacity of the Etla plant is 1000 hp, power being obtained from a waterfall which has a head of more than 400 ft. It is planned to erect the new plant higher up in the mountains where an abundant water-power is available, the waterfall being about 900 ft. The hydroelectric plant will have a capacity of 10,000 hp at the start, but this capacity can be enlarged from time to time as the demand for power may require. Transmission lines will be built to Oaxaca, Etla Taviche, Ocotlan and a number of other mining camps and towns of that section. The longest of these proposed transmission lines will be about 60 miles.

The Mexican Light & Power Company expects to have its transmission line completed into the Pachuca mining district and city by July 1, 1910. The line will run direct from the great hydroelectric plants of the company at Necaxa. It is stated that the mining companies operating in the Pachuca district, as well as many other industrial concerns there, have agreed to take electric power and that a big business is assured for the Mexican Light & Power Company. This company is already supplying El Oro mining camp with electric power. It is stated that the amount required in the Pachuca district is more than 25,000 hp.

The Pacific Government & Concession Corporation, Ltd., a Canadian concern, with headquarters at Victoria, British Columbia, is preparing to develop on a large scale several big tracts of virgin land, situated near the port of Zihuatanejo, State of Guerrero, which it recently purchased. In connection with the proposed improvements will be the erection of a large hydroelectric plant. It will place about 50,000 acres of land under irrigation by means of a system of storage reservoirs and canals which it will construct. The first of these storage dams will be located on the Petatlan River near El Paso Chino, and will have a capacity of 70,000,000 cu. ft. of water; the second dam will be located on the San Geronimito River and will have a capacity of 60,000,000 cu. ft. of water, and the third dam will be located on the Arroyo Arenoso, near El Salto, and will form a reservoir with a capacity of 50,000 cu. m of water. The Federal Government of Mexico has granted a liberal subsidy in aid of this enterprise, the amount to be paid when the 50,000 acres of land are brought under irrigation being $1,200,000 Mexican currency. The hydroelectric plant will supply power for the company's industries and for the towns in that section. Mr. John Lee Stark, who recently completed the installation of a water-works system at Zacatecas, has been given the contract for the building of the dams. Mr. William C. Bond is manager of the company.

The Chapala Hydroelectric & Irrigation Company, of Guadalajara, will build a branch transmission line from its distributing station in the Hostotipaquillo mining district to the canyons in the Sierra Madre range southwest of that place in order to furnish power for boring the great tunnels which the Southern Pacific Railroad must use on the line which it is building through the mountains. The main transmission line, which is being built into the Hostotipaquillo district, will be finished in about two months.

Mr. T. H. Swenton is preparing to install a hydroelectric plant in the Sierra Madre mountains north of Culiacan, State of Sinaloa, with a view to supplying a wide scope of territory with power for operating machinery of mines and other industries. It is stated that about 10,000 hp will be developed, which output of power can be increased as the demands may justify. The recent building of the Southern Pacific Railroad through that territory has caused a big awakening in the mining industry and all lines of business. A Government concession will be requested for the proposed electrical enterprise.

The project of building an electric railway from Ciudad Porfirio Diaz to San Carlos, State of Coahuila, a distance of about 50 miles, is in a fair way to be accomplished. It is stated that General Lorenzo Trevino, who owns an enormous tract of irrigated land through which the road will pass, and several other men of wealth, are back of the enterprise. The Chamber of Commerce of Ciudad Porfirio Diaz and the Industrial League of Eagle Pass, Tex., which is situated immediately opposite on the other side of the Rio Grande, are giving the project assistance. In connection with this proposed electric railway it is planned to install a large electric power plant in the heart of the coal fields, situated just south of Ciudad Porfirio Diaz. The refuse matter from the coal mines will be used for fuel and the power thus generated will be transmitted to several towns of that section and also used to operate the electric railway. The headquarters of General Trevino are at San Carlos.

The Government of the State of Jalisco has granted a concession to Mr. J. H. McCreery, of Pittsburgh, Pa., and Mr. Richard Ivey, of Guadalajara, Mexico, to build and operate an electric railway in the Hostotipaquillo mining district. The proposed line will run from the station of Magdalena, on the Southern Pacific Railroad of Mexico, to the town of Hostotipaquillo and to the principal mines of the district. The power will be supplied from a hydroelectric plant which will be erected on the Santiago River.

Dr. J. F. de la Garza, of Nuevo Laredo, State of Tamaulipas, is at the head of a syndicate of Mexican capitalists who will build an electric street railway in that city. It is announced that the capital for the proposed line has already been subscribed. It will connect with the electric railway of Laredo, Tex., on the international bridge across the Rio Grande.

Proposed New St. Lawrence Dam.

On behalf of certain American and Canadian capitalists who have for two years been seeking permission from the Dominion Government to construct a big power plant at the Long Sault Rapids on the St. Lawrence River, near Cornwall, plans have been filed with the Canadian Canals department looking to the removing of certain objections which have been raised by the shipping concerns as to interference with navigation on the river. The present project contemplates the erection of an enormous dam at the foot of the rapids, where there is a minimum head of 40 ft. and where it is possible to develop several hundred thousand horse-power. It is proposed to create a new channel on the American side of the river near Cornwall having sufficient depth for all boats on the river, and also to build a new lock there. The proposal is to be examined by the engineers of the various Dominion Government departments interested.

The new company is an amalgamation of the St. Lawrence Power Company, which has authority to develop power on the Canadian side, and the Long Sault Development Company holding a similar charter granted by the New York State Legislature for the American side of the river. Among those interested are Messrs. F. H. McGuigan, formerly of the Grand Trunk and Great Northern Railways, and Henry Holgate, civil engineer, of Montreal.

Hon. Geo. P. Graham, Minister of Railways and Canals, in speaking of the works contemplated by the amended plans, stated that the rapids at the foot of the Long Sault would be turned into a big lake by means of a dam constructed at that point, and a portion of the water thus conserved would be diverted into the Little Sault on the American side where a new channel would thus be provided capable of accommodating the largest vessels now navigating the river. The canal on the Canadian side at Cornwall would not be interfered with in any way, and what would be lost in the descent of the rapids would be made up by the gain made by the erection of the new improved channel. It was claimed that by adopting the new plans it would be possible to develop 150,000 hp as against 30,000 hp developed on the Canadian side of the river. The whole question was now under consideration by the Government awaiting the report of the engineers who would be appointed to go over the whole situation.

As a result of the amalgamation of interests, the parties con-

cerned in the power development have applied for incorporation by the Dominion Parliament as "The St. Lawrence Power Transmission Company," with a capital of $500,000, and headquarters at Montreal. The company asks for authority to import power from the United States and to export it across the boundary; also to amalgamate with any other company of a similar character.

New Colorado Hydroelectric Plants.

Plans have been filed with the State Engineer of Colorado for the Custer reservoir in San Miguel and Dolores Counties. Work was begun on this project Oct. 11 and it is anticipated that it will cost about $200,000. The dam is to be 110 ft. high and will impound 756,800 cu. ft. of water. The sources of supply are Disappointment Creek and Spring Creek. The water will be used for both irrigation and development of power. Mr. M. J. Bailey, of Cedar, Colo., is promoting the project.

The Orchard Mesa irrigation project, extending from Grand Junction to Palisade, in the richest fruit district in Colorado, will be completed well before the contract time, April, 1910. The bond issue per acre required has been very large owing to the equipment necessary for providing water to this territory. The tract varies from one-half to two miles in width and lies at an elevation of from 80 ft. to 200 ft. above the Grand River. There is a dam 350 ft. wide in the Grand River at point of intake and a canal extends west 10 miles to a point directly south of Palisade. At the end of the power canal are two centrifugal pumps which raise the water for irrigation purposes 40 ft. and 125 ft. respectively, delivered into two main canals, which have a combined length of about 30 miles, and which distribute the water to nearly all portions of the tract.

The canals are of concrete, and the power for driving the centrifugal pumps is generated by the dropping of 300 second-feet of water through turbine wheels direct-connected with the pumps. The head on the wheels varies from 72 ft. to 80 ft., depending on the stage of the river at the power plant.

Twelve miles of 36-in. pipe have been completed by the Central Colorado Power Company from Nederland to the Kosler reservoir from which the water drops 1860 ft. to the power house on Middle Boulder Creek. The steel pressure pipe is now being put in and at the lower end will sustain a pressure of 800 lb. to the square inch. The power house has been completed and most of the machinery installed. The dam is now 100 ft. above creek bed and the storage of flood waters will commence next spring. Excepting the dam, the power project will be practically completed Jan. 1. The initial installation will be 10,000 kw, supplementing the Shoshone plant of the Central Colorado Company, now supplying several thousand kilowatts to the Denver Gas & Electric Company.

Interference of Railway Circuits with Telephone and Telegraph Transmission.

The first fall meeting of the Boston Section of the American Institute of Electrical Engineers was held at the Edison Building, Boston, with Chairman Dugald C. Jackson presiding. Mr. J. B. Taylor, of the General Electric Company, Schenectady, N. Y., read his paper on "Telephone and Telegraph Systems as Affected by Alternating-Current Lines," as recently presented at the New York meeting of the Institute.

Chairman Jackson introduced the discussion by emphasizing the necessity for co-operation between the various interests concerned in line troubles and called upon Prof. Albert S. Richey, of the Worcester Polytechnic Institute, to give his experience with telephone lines paralleling high-tension circuits. Professor Richey stated that his experience had been from the standpoint of the direct-current railway operator in the Central States. The railway lines he had in charge were supplied with direct-current power, the telephone wires being on one side of the track and the feeders on the other. These telephone lines were transposed about every half mile and jack boxes were installed every quarter mile for the use of the car-service men. These were simple wooden boxes, with the bottom and part of the front entirely open to the air. The connections for the telephone leads were on the back of the box, with two brass binding posts for the terminals. This construction in itself made a fair ground on the telephone service every quarter mile, but as the ground was the same on each wire, the circuit was well balanced and the results were good. When high-tension work began the line potential was 16,000 volts, paralleling almost 100 miles of the telephone service. The transmission wires were carried on the tops of 40-ft. poles, with the telephone lines on the opposite side of the track. The service remained good, and later in building another 125 miles of transmission line for 30,000-volt service the telephones lines were installed in two sets on arms 10 ft. below the power wires. The telephone line was transposed every 16 poles for convenience in further subdivision of the transposition if necessary. Little trouble was experienced. The transpositions were regular, the lines well balanced and the telephone wires were near the ground electrically by their location close to the direct-current feeders. Trouble occurred whenever there were bad connections in the line wires, which unbalanced the lines. Great care was taken to have the linemen make good connections in the telephone circuits and the company substituted for the old-fashioned transposition with two transposition glasses and from four to six joints in the line wire, a transposition with a single glass, which introduced no additional joints in the line wire. This was a decided help. If the transmission service was in trouble, the telephone lines felt it. Professor Richey closed with the statement that in the case cited the telephone and the railway companies have common interests and are equally concerned with establishing and maintaining good service.

Mr. W. H. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, then submitted a statement regarding telephone troubles, which was read by Mr. N. J. Neill. This was used at the New York meeting and reported in these columns.

Mr. Sewall Cabot, of the Stone Telephone & Telegraph Company, Boston, referred to the system of metallic-circuit telephone lines mentioned by the author in which the first three lines are on a series basis and the remaining three on a multiple basis. He pointed out that in order to work such lines as this in connection with a railway system, going outward from a large city, it would be necessary to use repeater stations at both ends of the lines in order to connect them with other telegraph lines, and this would interfere with telegraph work because it is impossible to attach a grounded line to a metallic line without a repeater. In the multiple system the tendency would be for the action of the relays to be sluggish. He understood that there are two ways of remedying interference with the ordinary grounder telephone service. One is by means of the neutralizing wire with the compensating transformer for both current and potential, and the other by making what amounts to a three-wire trolley system. If a three-wire, single-phase system with the out-track of one polarity and the in-track of the other polarity were installed, and then those trolleys exchanged between track and track, this might be a virtual means of transposing the power system so that it would not cause disturbance with the telegraph and possibly not with telephone lines.

Mr. C. D. Jarvis, of the New England Telephone & Telegraph Company, stated that there is more difficulty in maintaining telephonic balances with the cables and apparatus than with the open wiring. Cables are made as well as they can be to obtain a very close balance, but even with the twisted pairs there is sometimes considerable difficulty in balancing for telephonic currents, especially where the so-called phantom circuits is provided, and which is operated over two telephone circuits. On a telephone circuit for ordinary commercial use it is not possible to impose upon it differential potentials higher than those common to telephone work, if good results are to be obtained. There is a great difference between local and toll practice in this respect. On the company's long toll lines, in order to meet the conditions of the public and increase the range of transmis-

sion, it is necessary, not only to employ open wires, but also to minimize the effect of capacity on this open construction by loading. These open wires are exposed to the field surrounding railway and power circuits, and there is no way of escaping them; but in the local distribution the company can use large numbers of conductors covered with a common lead sheath, which screens the conductors at least from any ordinary power circuit. In case of single-phase railway operation, the company is having trouble with the cables. The sheath is not effective as a screen in that case. On some of the New York lines a neutralizing transformer has been adopted. One of the open wires exposed to the New Haven electrification is damaged so much that the company has lost the open-wire efficiency entirely and might as well have cable to replace the open wires. Experience in telephone long-distance work in New England indicates that it will be necessary for the company to keep entirely away from electric light circuits. It is a question whether the company will be able to operate telephone lines on the same highway with power circuits. It is at present operating toll circuits in some cases for 10 miles parallel to power lines. Disturbances have not been entirely eliminated, although the telephone company is on the opposite side of the road. It has suffered repeatedly when there have been defects on the power system, the whole system often being at a standstill for several hours. In one case, where the two services parallel for five miles, the telephone lines have in the past year been thrown out of operation for three or four hours at a time. In this case the power circuit had a potential of 33,000 volts with a grounded neutral, and the induced current in the telephone lines was large enough to operate the arresters. It is not unlikely that the presence of power and lighting wires will ultimately drive the telephone company off the highways.

Mr. Taylor closed the discussion by stating that a comparison of notes and a discussion of the conditions by the different interests will often permit the settlement of troubles at small cost. A direct-current trolley wire may give some trouble as a result of commutated current at the motors and generators. A submarine cable carried overland down toward Coney Island gave troubles which were hard to account for, and the difficulty was finally tracked down to a point where the overhead wire ran close to the overhead trolley, the latter having a defective ear, which sparked badly with each passing car. Unbalancing of joints is as important as anything else. If a transposition is used in a form which causes joints, there may be more trouble than one would have without the transposition. A form of transposition where the wires do not have to be cut is desirable. He agreed with Mr. Cabot's criticisms. The multiple telegraph has not had a fair and commercial trial over a line of any length, and if attempted, the relays will have to be different or more carefully adjusted than the present types. The three-wire trolley plan is at present merely a paper scheme.

Radio-Telephony.

At a meeting of the Wireless Institute, held in the Engineering Societies Building, New York, on Nov. 3, an illustrated lecture on radio-telephony was delivered by Mr. Alfred N. Goldsmith. The speaker outlined the characteristic features of all wireless telephone installations which embody means for producing sustained oscillations having a frequency above the audible range and devices for varying the amplitude of the vibrations in accordance with the sounds to be transmitted. The high frequency oscillations can be produced directly by an alternating-current generator, as has been done by Fessenden, or by a resonating circuit shunted around a direct-current arc, as was done by Duddell when he devised the "singing arc." Upon the inductance and capacity in the resonating circuit depends the frequency of the oscillations, while the resistance in circuit determines whether the current in the arc will be oscillatory or unidirectional; in order for it to be oscillatory the total resistance in circuit must be of such a nature that an increase in current results in a decrease in voltage at the arc. Better results are obtained when the arc is formed in some gas other than oxygen or air; hydrogen and alcohol have been used successfully for this purpose. In order to permit a high voltage to be impressed across the arc, use is made of a magnetic field surrounding the arc.

For the transmitter proper use is made of carbon microphones, sometimes with as many as eight in series on an e.m.f. of 440 volts. Condenser types of transmitters are also employed. Between the high-frequency transmitter circuit and the aerial the coupling is always inductive and very loose, the object being to minimize all damping influences. The receivers are of the telephonic type familiar in wireless telegraph work, such as the DeForest "audion."

In comparison with wire telephony, wireless telephony possesses the decided advantage of transmitting speech without distortion quite independent of the distance. The author expressed the opinion that wireless telephony will prove useful for long-distance trunk-line communications as well as for communications between ships.

The next meeting of the Wireless Institute will be held on Dec. 1, at which time a paper will be presented by Mr. W. E. Smith, entitled "Conversion of Electric Oscillations Into Continuous Current by Means of the Vacuum Valve."

Boiler and Engine Questions at the Colorado Convention.

At the convention of the Colorado Electric Light, Power & Railway Association at Denver in October, a Question Box occupied parts of the program and the questions relating to boilers and engines which were discussed are given here with notes on some of the answers.

1. What is being done to prevent smoke nuisance? Have you received any complaints? Do you burn lignite or bituminous coal, and which gives the less amount of smoke?—Mr. J. F. Vail, of Pueblo, said his company had stokers which afforded smokeless combustion except when working the furnaces at less than full load of the boilers and in starting and shutting down. Smokeless combustion being partly a matter of furnace temperature, whenever the furnace falls below a certain temperature, as it does on light loads, the furnace will smoke.

2. Are any stations in the State using superheated steam, and do they advise it?—Mr. J. F. Dostal, of the Denver Gas & Electric Company, reported in the affirmative on both questions for turbines.

3. Are any stations in the State using automatic "runaway stops" for engines?—The Denver City Tramway has them, and believes in them.

4. Is the vacuum system of handling ashes a success?—Mr. Vail, of Pueblo, said that the installation at his plant is a success, but that there was some trouble at first because no account was taken of the lower vacuum obtainable at the altitude of Pueblo as compared with Eastern cities. Use is made of a 30-hp motor.

6. Are there any low-pressure turbines in operation in this vicinity?—The Colorado Springs Electric Company has some low-pressure turbines taking the exhaust of compound low-speed engines which were formerly run non-condensing. A cooling tower is used to supply condensing water.

7. It is necessary to connect a low-pressure steam turbine unit so as to operate in parallel with the high-pressure unit or can they supply energy to separate feeders?—It was agreed that they would have to be connected in parallel unless a steam-heat accumulator or regenerator is connected between the engine and the low-pressure turbine. Such regenerators are used in steel mills where the load is greatly fluctuating.

8. What type of cooling tower is most efficient? What percentage of water must be added?—Mr. Dostal said that the Denver Gas & Electric Company has two towers of the stack type. The water required is less than that required for boiler feeding.

9. Are there any gas producer plants successfully operating

electric light plants in the Rocky Mountain territory?—Mr. W. A. Carter, of Denver, said that the Western Chemical Company, of Denver, has a Westinghouse producer working on lignite coal and supplying gas to an engine and also to furnaces. It is operated continuously. Mr. J. R. Cravath, of Chicago, said that he had investigated a number of central stations using producers farther east. His conclusions were that any company installing a producer and gas engine should allow plenty of time for the training in of operators before depending on the engine for regular service. Given a proper chance to train operators, the producer and gas engine combination is an excellent one for a large number of central stations, of small size, both as regards economy and reliability.

10. Has anyone in this territory tried driving an induction motor above normal speed in parallel with generators?—Mr. John A. Clay, of the Animas Power & Water Company, said that this is being successfully done on mine tramways. It has been recently proposed and advocated for large stations to install some generators of the induction type in order to reduce the current which will be produced when there is a short circuit.

11. Is there a surge of current between high-speed and low-speed alternating-current generators when operating in parallel?—Mr. F. P. Cummings, of Denver, reported that when the water-turbine plant of the Central Colorado Power Company is operating in parallel with the steam engine and turbine-driven plant of the Denver Gas & Electric Company, at very light load there is some surging. The surging does not occur at heavy load. The surging may not be due to the difference in rated speeds of the turbines, however. Mr. H. L. Corbett, of Georgetown, reported that the United Hydroelectric Company is operating without trouble alternators driven by all kinds of prime movers in parallel—namely, waterwheels, steam turbines and Corliss engines. Mr. Lawler reported the same combination at Colorado Springs. The most surging is experienced on light load and low power factor.

Milwaukee Boiler Explosion Demonstrates One Advantage of Electric Drive.

As the result of a steam explosion in the large new power plant of the Pabst Brewery in Milwaukee (described in *Electrical World* of Feb. 4, 1909), at 4:40 a. m., on Oct. 25, the boiler plant was completely wrecked and much damage was done to surrounding buildings, the whole loss due to the explosion being estimated at $250,000. One man, a fireman, is missing, and it is supposed that he was killed, while another fireman was seriously injured. There were eight 400-hp water-tube boilers in the plant, and four of these exploded. The cause of the accident is not known, although low water and other conjectures have been advanced. The boilers were set singly without brickwork, but encased in a steel shell lined with tile and asbestos. The plant was designed for a normal steam pressure of 160 lb. and was carefully tested before acceptance. The quality of the metal used in the boilers was demonstrated by the fact that pieces of 9/16-in. steel were found folded together as the result of the accident as easily as a piece of leather or cloth would be folded, and without a crack.

The force of the explosion was very great. One large section of a boiler, weighing apparently several tons, was hurled high in the air, clear across Tenth Street, and embedded so firmly in the roof of an adjacent building 50 ft. or 60 ft. above the street that it was removed with great difficulty. Tenth Street from Chestnut Street to Cold Spring Avenue was buried under a great mass of broken machinery, twisted iron and steel and piles of brick. Panes of glass in stores and houses within a radius of two blocks were broken, and many people in the vicinity thought that an earthquake had taken place.

The brewery is electrically operated to an unusual extent, as related in the descriptive article in *Electrical World* to which allusion has been made. This condition proved very fortunate at the time of the disaster, for it enabled a temporary connection to be made with the central-station company so that the work in the great establishment in nearly all departments could be resumed speedily, and this saved thousands of bushels of grain in progress through the brewery from spoiling. There is a 13,200-volt, 25-cycle power circuit of the Milwaukee Electric Railway & Light Company in Chestnut Street. Soon after 6 o'clock on the morning of Oct. 25 Superintendent O. M. Rau, of that company, was communicated with, and preparations were begun at once to make an emergency connection to operate the brewery. Three large transformers were installed in the engine-room of the power plant (which is some distance from the boiler-room and was not injured). These are air-cooled transformers, and a motor-operated fan was also installed to cool them. By means of these transformers the 13,200-volt, three-phase energy was transformed down to 440 volts and fed into the busbars of the brewery power station switchboard. This work was done within 18 hours, and the day after the accident all departments of the establishment were in operation except the pasteurizing and brewing departments. The celerity with which this temporary supply could be arranged was a striking tribute to the advantage of electric drive in an emergency like this.

In clearing away the débris the oxhydric process of the Falk Manufacturing Company was used for cutting the iron and

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steel beams. This process is based on the principle of the oxy-hydrogen blow-pipe. Mr. Lulli, an Italian, who is spoken of as the inventor of the oxhydric process of cutting metals, met with an accident in the process of clearing away the great mass of wreckage. He fell with a section of the débris and was picked up in an unconscious condition, but it is not believed that his injuries are serious.

Rather curiously, the brick chimney, 225 ft. high, which was a part of the power plant, escaped apparently without injury. Supported by this chimney are the aerial wires of the United Wireless Telegraph Company, and a wireless operator was able to give service as usual on the day of the accident. A section of the large malt elevator adjoining the boiler plant on the south and partly filled with grain was moved 3 ft. from its foundations and pushed to one side until it extended over an alley.

Co-operation of School and Factory in Industrial Education.

"The New Apprentice System as Developed in Combination with Educational Institutions" was the subject of Dean P. B. Woodworth, professor of electrical engineering at Lewis Institute, Chicago, at the meeting of the Electric Club of that city on Nov. 3. The speaker, who was followed with great

attention, described the new work at Lewis Institute by which boys are enabled to give half of their time to regular work in factory or workshop and the other half to a specially prepared practical course of instruction in the school, thus dovetailing instruction in practice and theory.

Professor Woodworth began by giving his version of an old saying, "Be sure you are right and then go ahead—and you won't go at all." To make progress one must be willing to take the risk of making mistakes. That has been the feeling in introducing the new course at Lewis Institute by which the boys go to school one week and then work another week, so alternating school and work a week at a time. Each boy has a mate, so that while one boy is in school the other is in the factory, and vice versa. This is substantially the scheme of the University of Cincinnati, which has attracted much attention, with the exception that in Cincinnati the students are required to be high-school graduates, while this stipulation is not made at Lewis Institute.

Manufacturing companies are asked to nominate two boys or more to take the course, there being no limit to the number at present, except that it must be a multiple of two. A number of concerns, principally in the metal trades, have responded to this invitation, among them the Aeromotor Company, the Allis-Chalmers Company, the Link-Belt Company and the Woods Motor Vehicle Company. Forty-seven boys have been in the course since it was established on Jan. 1. Of these 23 have dropped out for various reasons, and there are to-day 24 boys in the course, which makes a continuous class of 12, half working in their respective places of employment each alternate week, as explained.

The boys come to school at 8:30 a. m. and study physics for two hours. From 10.30 to 11.30 they have mathematics, and from 11:30 to 12:30 are given instruction in English. In physics the boys seem to shine particularly in the laboratory work. The training of their hands by practical work fits them for the demonstrations at the bench in the physics classroom. The instructor in mathematics follows up the work in physics, and in the hour devoted to English the students talk over the earlier work of the day or perhaps write an account of what they have done. Thus the three subjects are very closely related and are mutually helpful. The results are excellent, and the instructors are enthusiastic over the good work done by their pupils. In the afternoon there is instruction in mechanical drawing, pattern making, shop or foundry work. The school day is supposed to close at 5 p. m. in this course, but often the boys are so interested that they linger longer.

An ordinary school year is of about 1000 hours' duration. The new plan provides only for alternate weeks in school, but it runs right through the year, for the school is always open, although in summer more attention is paid to laboratory work. The school hours under the alternating scheme total 900, so that the difference between the amount of instruction given in this way and by the ordinary arrangement is not great. The students, who are termed co-operative students, seem to get along more rapidly than the regular day-school pupils. One reason for this is that they are themselves eager for the work.

Classifying the 23 who dropped out of the course, Professor Woodworth said that eight were dissatisfied with the shop where they were employed; eight were asked to leave because they did not evince sufficient interest; one dropped out owing to lack of ability; one was removed by parents; one left because he felt that he should be earning more than $10 a month, which he received for his half time. The others dropped out for reasons that are not ascertained. The age limit of students is from 16 to 20 years. Analyzing the ages of the boys now taking the co-operative course, it is found that two are 19 years old, ten are 18, nine 17 and three 16. Of the 24 students, 10 have put in one or more years in high school. The others did not get farther than the grade schools.

The employers seem to expect that the boys will get hold of the fundamentals of mechanics and that some time these boys will become shop foremen; but the speaker remarked that if you give the boy a chance you can't stop him, and it is the intention of the school to give the working boy a chance. The superintendents of the employing companies and the instructors at Lewis Institute hold occasional conferences which are mutually helpful. It is too early to speak with confidence of the results of this course, but the outlook is most promising. The idea of alternating outside work and school instruction is not new at Lewis Institute. Of a recent class of 14 graduates in mechanical engineering, the average student had earned $3,000 up to the time of graduation, according to a statement made by Director Carman.

More co-operative students can be taken at the school. There are now two classes of 12 students each, and these classes should consist of 25 or 30 boys each. The plan is for a two-year period. The work is of a generally elementary nature, and it is not expected that the boys will be carried far enough so that the instruction need be differentiated in relation to mechanical, electrical or chemical engineering. The boys are paid usually $1 a day for their work by their employer, although there is nothing to prevent a boy getting more if he makes an arrangement to that effect. Of the $14 paid to the school by the manufacturer for the boy, $10 a month goes to the boy himself and $4 to the school. It is the aim of Lewis Institute to duplicate from its own resources the amount of money paid in by pupils of any class for their instruction.

Employers are not limited as to the number of boys they may send to the school, but the largest number from any one shop now is six. The course extends over 50 weeks in a year—26 weeks in the shop and 24 in the school, the first two weeks in September being a vacation from school for students of this class. On Saturday both the boys in the team of two meet in the school.

Mr. F. P. Vose, in the discussion, spoke of the false idea that a gentleman was one with educated head and not educated hands.

Mr. Frank L. Perry, recounting some of his own experiences, spoke of the great advantage of the Lewis Institute plan over the night school. After working hard all day boys are half asleep in night school, and their intellectual faculties are not at their best; the plan of going one week to school and one week to work is much better. Manufacturers should be glad to enter their human machines in the schools to be polished and made more effective to do work for their employers.

Mr. C. H. Roth spoke highly of the co-operative plan, and referred particularly to the work at the University of Cincinnati.

Mr. Thelin, a graduate of Lewis Institute, spoke as one who had tried the plan in practice and found it good. He worked for the Commonwealth Edison Company and was permitted to go to school at Lewis Institute for half of each day. He found the combination of practical work and technical instruction very effective and was pleased at the opportunity to give his testimony to the value of the idea which Professor Woodworth had set forth.

New York Meeting of the American Electrochemical Society.

The sixteenth general meeting of the American Electrochemical Society was held in New York City on Oct. 28, 29 and 30. With respect to the attendance, the importance of the papers presented and the enjoyment of the social features, the meeting was one of the most successful held by the society. The number of those who registered was above 350.

Sessions for the reading and discussion of papers were held on Thursday afternoon at the Chemists' Club, and on Saturday morning and Saturday afternoon at Earl Hall, Columbia University. Abstracts of all the papers will be found below.

The whole of Friday was devoted to an excursion to the chemical and metallurgical industries of Bayonne, N. J. The plants of the Standard Oil Company, National Sulphur Company, Pacific Coast Borax Company, and the Gröndaly briquetting plant at the works of the General Chemical Company were

visited in the morning. At the lunch at noon, the Mayor of Bayonne, Hon. Pierre P. Garvin, spoke of Bayonne as an industrial center, emphasizing its vast possibilities with respect to available waterfront and railroad connections. In the afternoon the works of the Babcock & Wilcox Company, the Electro-Dynamic Company, the Electric Launch Company and the Industrial Oxygen Company were visited.

In the evening of Friday a very enjoyable subscription dinner was held at the Hotel Cumberland. Dr. Doremus acted as toastmaster, and speeches were made by President Dr. Baekeland, Prof. Armstrong, of London; Dr. Nichols, Dr. Loeb, Mr. Toch, Dr. Richards and Dr. Wiley. In the evening of Saturday the society was the guest of the Chemists' Club at a smoker in the clubhouse.

Special arrangements had been made for the entertainment of ladies, including a reception and tea by invitation of Mrs. W. H. Nichols at the Waldorf-Astoria, on Thursday afternoon; an automobile ride and tea at the Claremont on Friday afternoon, and a theater party on Saturday. A large number of ladies also participated in the dinner on Friday night.

Much of the success of the convention is due to the indefatigable work of the president, Dr. Leo Baekeland; the secretary, Dr. J. D. Richards, and the secretary of the New York section, Mr. A. von Isakovics.

TITANIUM ARC.

The first paper of the Thursday session was presented by Dr. W. S. Weedon. In a long extended research carried out by the General Electric Company a large number of elements, compounds and mixtures were investigated as to their suitability for arc-lamp construction. It was found that titanium carbide was most promising with a view of getting a high efficiency. The titanium-carbide electrode is the cathode and placed below an anode of copper, the latter being inactive and not wasting appreciably. The light is almost pure white, only the faintest tinge of yellow being noticed when observed from a distance. The titanium arc is a flame arc and its efficiency increases with increasing current density and with increasing arc length.

At 3 amp, 103 volts and 1-in. arc length, it consumes only 0.228 watt per horizontal candle-power. The mean spherical candle-power at 2.87 amp, 95 volts (273 watts) is 535, and the mean hemispherical candle-power 737.6. On this basis the specific power consumption is 0.51 watt per mean spherical candle-power, and 0.37 watt per mean hemispherical candle-power; this value corresponds to a yield of 1.96 mean spherical candle-power, or 2.70 mean hemispherical candle-power per watt. The electrical measurements given were made at the arc terminals and the photometric measurements were made through a clear glass globe of the usual thickness.

A study of the efficiency curves shows that titanium-carbide arcs are most satisfactorily operated on a constant-current circuit rather than on a low-voltage multiple circuit, with the necessarily short arc length. Some notes were given on the preparation of titanium carbide electrodes and also on the use of titanium sub-oxide for a direct-current arc lamp. The titanium sub-oxide is prepared by the reduction of rutile. The character of its arc is almost identical with that of the carbide, but the light is much steadier and the efficiency is even better. However, there are certain objections to the use of this electrode and it cannot well be operated with alternating current.

In the discussion which followed reference was made to the use of zirconium carbide, and it was stated by Dr. Weedon that the efficiency of the zirconium-carbide arc is less than that of the titanium-carbide arc.

BORON.

The second paper was presented by Dr. E. Weintraub, giving a most interesting review of several years' work in the research laboratory of the General Electric Company with the element boron. The author has gone far beyond Moissan and has prepared pure fused boron with the aid of an arc discharge similar to that producing nitric acid from air. The chemical reaction is the change from boron chloride and hydrogen into hydrochloric acid and fused foron. Fused boron is a very hard material. It is very much like black diamond, although not quite as hard as the diamond, yet harder than any other material. Boron seems to have important technical applications on account of its electrical properties. At ordinary temperatures it has a very high specific resistance, but this drops at a most unusual rate when the temperature increases. There is also a possibility of making alloys having any desired negative coefficient. Several of his preparations were exhibited.

SILUNDUM.

A paper by Prof. S. A. Tucker, H. F. Kudlich and E. M. Heumann on the preparation of silundum was presented by Prof. Tucker. Silundum is a name given to carbon articles which have been partially converted into carborundum in the electric furnace. Its most valuable property and probable use is its ability to withstand a high temperature in the air without sensibly undergoing oxidation, and, as it is a conductor of electricity, its use as a resistor material. It is a satisfactory material for temperatures up to 1500 deg. C.

ELECTRO-ANALYSIS.

On the invitation of the board of directors, Prof. E. F. Smith, of the University of Pennsylvania, presented a most interesting experimental lecture on recent developments in electro-analysis. Dr. Smith has been the leader in these developments for many years and his lecture was a very suggestive human document. He traced the gradual evolution of the different methods which have made electro-analysis such a simple and convenient procedure, speaking first of the use of rotating anodes, then of the use of mercury as cathode, and finally of the use of a double-compartment cell with mercury as connecting bipolar electrode. The lecture was illustrated by many experiments which showed the convenience and quickness of electrolytic analysis.

Two papers were presented at the beginning of the Saturday morning session, in the absence of the authors, in abstract by the secretary, Dr. Richards. The first was a paper by Dr. R. C. Palmer on the production of explosive antimony by electrolysis of non-aqueous solutions. The second paper dealt with the electrolytic production of perchloric acid, the author being Mr. F. C. Mathers; he proposes to use perchlorate baths for electroplating.

ELECTRODE LOSSES IN ELECTRIC FURNACES.

Four papers were then presented on electrode losses in electric furnaces. This loss is of importance because with improper design the electrode of an electric furnace may form the weak point in the heat insulation of the furnace and may tend to chill the furnace.

The first paper was presented by Mr. Carl Hering, who outlined the laws of the electric losses. They are as follows:

The combined loss through the cold end of an electrode is equivalent to the sum of the loss by heat conduction alone (when there is no current) and half the I^2R (Joulean heat) loss.

This combined loss will be at least when the loss by heat conduction alone is made equal to half the I^2R loss; the total loss will then be equal to the I^2R loss, and no heat will be conducted from the interior of the furnace.

This minimum loss is dependent only on the material, current and temperature, but not on the absolute dimensions; it merely fixes the relation of the cross-section to the length, but leaves a choice of either; this best ratio of cross-section to length is $S \div L = 0.3456\, I \sqrt{\frac{r}{kT}}$, where S is the cross-section in square inches, L the length in inches, I the current in amperes, r the "mean" electrical conductivity in ohms, cubic-inch units, k the heat conductivity in gram calories per second per cubic inch, and T the temperature difference between the hot and cold ends.

For each material there is a definite minimum loss of electrode voltage which depends only on the temperature and is

independent of the dimensions or the normal current for which the furnace is designed; hence,

The best possible electrode efficiency for any material may be determined from the total voltage of the furnace and this minimum voltage due to the material and to the temperature, and is independent of the dimensions.

The heat gradient of the combined flow is equal to the sum of the heat gradients of the individual flows.

A numerical application of his conclusions for carbon and graphite was also given by Mr. Hering.

In a second paper of Mr. Hering it was shown how to determine experimentally the mean heat conductivity and mean electric resistivity of an electrode material. The method, which is quite simple experimentally, is based on the laws of electrode losses as described above.

A paper by Mr. C. A. Hansen, of the General Electric Company, discussed the same subject with special reference to some difficulties in applying the theoretical formulas in practice. One of the difficulties is the selection of the length of an electrode in using the theoretical formulas. His results show the "effective length" to be the entire length of electrode from center of waterjacket to extreme hot end.

Mr. Hansen also showed how the contact resistance can be taken care of in the formulas. He also gave the results of an application of the theory to a special ferro-titanium furnace with a temperature of 3200 deg. C. at the hot end in the furnace and 200 deg. C. at the cold end outside the furnace. Under these conditions he found the following mean values for the electric resistivity of graphite and carbon and the heat conductivity of the same materials:

The mean resistivity of graphite under conditions applicable to a temperature difference of 3000 deg. C. is 0.00032 ohm per inch-cube = 0.000812 ohm per cm-cube. The mean resistivity of carbon under same conditions may be taken as 0.00072 ohm per inch-cube or 0.00183 ohm per cm-cube.

Ratio of carbon resistance to graphite resistance under these conditions is 2.25. The mean heat conductivity of graphite from 3200 deg. C. to 200 deg. C. = 1.3 watt-seconds per second per degree Centigrade for 1 in. length and 1 sq. in. section = 0.127 c.g.s. units. The mean heat conductivity of carbon under the same conditions is 0.13 watt-seconds per second per degree Centigrade for 1 in. length and 1 sq. in. section = 0.0127 c.g.s. units. Mr. Hensen also emphasized that the current density is of importance, as he found by experience that when exceeding a current density of 150 amp per square inch for graphite, and 50 amp per square inch for carbon electrodes, the end walls of the furnace became badly corroded. From these data and from the ratio of cross-section by length, it is always possible to calculate the best length which an electrode should have.

A fourth paper on electrode losses was presented by Dr. E. F. Roeber. The author stated that there are two ways of attacking this problem. The first is to consider an infinitely small particle in the same way as in the classical mathematical theory of heat, to see what happens there, and then to integrate over the whole electrode. This method leads to great mathematical difficulties in the integration, due to the change of heat and electric conductivities with the temperature. There is, however, a second method in which the electrode is considered from the start as a whole. It is possible to arrive at the fundamental equations of the theory by elementary considerations without any assumption as to the changes of heat and electric conductivities with the temperature. The resulting formulas contain mean values of the conductivities. These mean values are not mathematically defined, but can easily be measured by some such method as proposed in Mr. Hering's second paper. Then there can be no objection to the exactness of the theory.

There was quite an extended discussion on the subject of electric losses, participated in by Dr. Richards, Mr. Grower, Mr. Hering and Mr. Hansen, and a communicated discussion by Dr. Kennelly.

PRACTICAL CONDUCTANCE OF ELECTROLYTES.

A paper by Prof. J. W. Richards and Prof. W. S. Landis was then read by Prof. Richards. The authors discussed the actual conductance of the electrolyte in electrolytic refining tanks as the same are ordinarily set up and operated. In almost all refining tanks the edges of the anode and cathode plates, they being usually of the same size, are at some distance from the sides and bottom of the tanks. The free space, that not directly included between the plates, is a field through which stray current flows, the current lines being usually curved; it adds considerably to the conductance of the electrolyte. The authors have made an extended series of measurements of the conductance of electrolytic baths with more or less free space below the electrodes, and have plotted their results in the form of curves, by the use of which it is easy to determine in any case what will be the practical conductance. A maximum conductance is reached when the free space below the electrodes has reached a certain depth, so that it is useless to increase the depth of the electrolyte underneath or at the sides of the electrodes past a certain point, as any such increase in the dimensions adds nothing to the conductance.

The uselessness of increasing the depth (width) of an electrical metallic conductor conducting between points of contact at the two ends on the same side, beyond a certain depth which is approximately the ratio of depth to length of 1/5, is quite as important for the electrical engineer, in the design of equalizing bars and heavy busbars of short lengths, and shows the great importance of making contact over the whole end or face of the conductor in order to get the full utilization of the metal comprising it. Connection should never be made along an edge or at the corners.

The paper was discussed at some length by Messrs. Wolcott, Loeb, Sperry, Hering and Baekeland.

CORROSION OF IRON.

The last paper of the Saturday morning session was presented by Mr. Maxmilian Toch, who referred to an observation made by Mr. Sperry, namely, that the treatment of a piece of iron as cathode in a sodium carbonate solution of certain strength at a low voltage and at a high amperage makes the iron immune against corrosion. The paper was only of a preliminary nature, but Mr. Toch exhibited some interesting iron articles which showed more or less corrosion according to their treatment. The paper was discussed by Mr. Sadtler, Mr. Sperry, and Mr. Gaines. The latter emphasized that bacterial activity may be an important feature in corrosion.

DRY CELLS.

The first paper of the afternoon session was presented by Mr. F. H. Loveridge, giving a summary of typical dry cell tests of constant resistance. The results were given in a series of curves which show how to judge the quality of a dry cell. In the discussion which followed it was emphasized that standardization rules should be formulated on dry-cell tests, and a committee to take up this matter will be appointed by the president, Dr. Baekeland. This subject was discussed at more length. Dr. Whitney suggested that perhaps two kinds of tests might be formulated, one for the interrupted service and the other for continuous service. Prof. Burges thought that constant current tests would be preferable, while Dr. Sharp thought that while constant-current tests are more convenient for testing a great number of cells in series at the same time, yet a test at constant resistance comes nearer to the use of the cell in actual practice.

The effects of chemical impurities upon the electrical characteristics of dry cells were discussed in a paper by Messrs. C. F. Burgess and Carl Hambuechen. The authors stated that about 80 per cent of the dry cells in use are of the cylindrical form, the zinc container being 6 in. high and 2.5 in. in diameter, a carbon rod serving as the cathode. A representative filling mixture consists of 10 parts of manganese dioxide, 10 parts of powdered carbon, 2 parts of ammonium chloride and 1 part of zinc chloride, sufficient water being added to give the proper amount of electrolyte to the cell. Mercury is occasionally added to effect amalgamations and prolong the life of the zinc. Upon the amount and availability of the manganese dioxide depend the qualities designated as "minimum prolongation" and "maximum recuperative power." Granulated carbon or graphite is employed

to give conductivity to the mixture. The ammonium chloride acts upon the zinc chloride formed as a result of the corrosion of the zinc to produce various single and double chlorides, the latter being less soluble than the former. The insoluble double chlorides crowd out the electrolyte and increase the resistance of the cell. Dry-cell construction can be improved by reducing the accumulation of insoluble non-conductive materials.

The authors called attention to the need for a logical method of rating dry cells, and suggest the use of a rating based on the energy output. On this basis the cell described above would be rated at about 30 watt-hours.

AN ELECTRIC FURNACE FOR IRON ORE REDUCTION.

Mr. Edward R. Taylor then read a paper on a special design of an electric furnace for the reduction of iron ore. Its features show quite some similarity with his well-known carbon by-sulphide furnace with respect to the arrangement of the electrodes and the method of pushing the charge forward by means of screws. The ore and the carbon are charged separately into the furnace in order to convert as much as possible of the carbon into CO_2, instead of CO_1, and thus increase the efficiency of the furnace.

MANUFACTURE OF AIR-SALTPETER.

The process used by the Badische Anilin & Soda-Fabrik for manufacturing air-saltpeter was fully described in a paper by Dr. Schönherr. In this process use is made of a tube in the axis of which the arc burns, a current of air being passed along the length of the arc in spiral form. The tube consists of an ordinary iron pipe, the upper part of which is provided with a special cooler which joins the upper electrode. The lower electrode is an iron bar centrally placed within the tube and insulated therefrom. There are no moving parts and no electromagnets. The author stated that the process furnishes the nitric oxide in a far higher concentration than most other processes.

An experimental plant at Christianssand, Norway, which has been in service for two years, utilizes 1800 hp in three 600-hp furnaces, each of which operates at 4200 volts single phase; the arc is about 16 ft. long. Arrangements are being made for installing ten 14,000-hp turbines for using the water of the Rjukan in the interior of Telemarken for manufacturing nitrate in a factory to be placed in operation in 1910. Moreover, concessions have been obtained for water-power amounting to 300,000 kw to be used in this new industry in Norway.

ENERGY FOR ELECTROLYTIC REFINERIES.

Mr. W. L. Spalding, who is connected with a large copper refinery in Buffalo, discussed in an interesting paper the importance of cheap energy for electrolytic refineries. The energy cost in electrolytic refineries is 40 per cent of the cost of converting anode to cathode copper, or 20 per cent of the cost including furnace treatment.

He reviewed briefly the use of steam power, gas power, and water-power, and the buying of electric energy.

In Buffalo the cost of the Niagara Falls energy in lots of 500 hp or over is $27.50 per horse-power year; converted to direct current at 87 per cent efficiency the cost equals $31.60, which is surprisingly large for a region situated near a source of vast water-power. The refiner who wishes to use both waste heat from his furnaces and electric power for electrolysis is confronted by the interesting problem of combining the two so as to secure minimum cost per ton of output. The most satisfactory way seems to supply a tank house circuit with two generators in parallel, one driven by a motor running on a constant amount of the purchased power, the other driven by a steam engine whose load varies with the steam.

This arrangement permits the load to be divided in any ratio between the two generators by hand or automatic regulation of the shunt field rheostats, or the engine to be shut down on Sundays and during the dipping of the furnace charges when the supply of steam is not more than sufficient for driving air compressors, pumps, etc., and heating or evaporating the electrolyte. At large ratios of the two loads the equilibrium is delicate, but not disturbed. The author finally emphasized that an electrolytic copper refinery is an ideal customer for a distributing company.

IRON-COPPER ALLOYS.

Messrs. C. F. Burgess and James Aston discussed the physical properties of iron-copper alloys in a paper giving much data relating to alloys of iron with from 0.1 per cent to 7.0 per cent copper. Under tensile tests unannealed alloys showed a yielding point varying from 52,580 lb. per sq. in. for 0.1 per cent copper to 122,900 for 7 per cent copper. The elongation in a 2-in. length varied from 28.5 per cent to 4.0, respectively, under the same condition. When annealed the 0.1 per cent copper alloy showed a yield point at 35,570 lb. per sq. in., and an elongation of 31.5 per cent; the 70 per cent alloy showed a yield point at 56,950 with an elongation of 17 per cent.

The authors remarked that their results and comparisons would indicate that the copper-iron alloys are worthy of consideration and might be comparable to the nickel steels in use, even if the strength should not reach such high values as those of the nickel. A 1.5 per cent copper alloy is of promise, since the smaller percentage required and the lessened cost per pound of copper as compared with nickel would result in a lessened cost of construction, even if there is some increase in tonnage required because of the slight decreased strength for equal weight.

ELECTRO-CEMENTIZING.

A paper by Mr. Alfred Sang described a process for simultaneously annealing, cleaning and coating a steel wire with zinc, the result being similar to that obtained with the sherardizing process. Use is made of electricity in the wire itself for raising its temperature, while in the sherardizing process heat is passed to the wire through a non-conducting mass of zinc dust. The wire is passed over brass contact sheaves through a mixture of crushed coal and oxide of zinc. By means of current the wire is quickly brought to a cherry red, at which temperature all grease is volatilized, scale or rust is reduced by the carbon and occluded gases are driven out; at the same time, the zinc oxide in immediate contact is reduced, and, as a vapor, enters the pores of the steel and condenses on the surface when the temperature is lowered as the wire enters the upper part of the furnace. The author claimed that the reduction yields a coating of pure distilled zinc which is thoroughly alloyed to the metal underneath.

The following two papers were presented in abstract in the absence of the authors.

A paper by Dr. M. DeKay Thompson on calcium carbide dealt with the equilibrium pressure of carbon monoxide in the monovariant system, consisting of this gas, lime, carbon and calcium carbide. The paper was discussed by Mr. Hansen.

A paper by Mr. F. C. Frary and W. L. Badger discussed a method of preparation of calcium in the laboratory, and some peculiar effects observed in it.

Mr. Taylor presented two resolutions which were adopted recommending the work of the National Conservation Commission and the Inland Waterways Commission, and of the work of the New York Water Supply Commission and referred to the importance of cheap water-power rendered available by the conservation policy for electrochemical and metallurgical industries. Mr. Hering proposed a vote of thanks to all who had made the meeting successful. The meeting then adjourned. The next meeting will be held in the spring of 1910 at Pittsburgh.

State Regulation of Public Utilities in Wisconsin.

An address was delivered before the Wisconsin State Bar Association at Milwaukee on Sept. 1 by Mr. John H. Roemer, member of the Railroad Commission of Wisconsin, on the subject, "Some Features of State Regulation of Public Utilities." Mr. Roemer said that the scheme of State supervision of pub-

lic utilities embraced in the public-utilities law of Wisconsin was the most comprehensive in all its economic aspects and the most effective of any law of the kind in existence. While intelligent judgment could not be passed at this time upon the final results of the operation of the law, or prediction made with any degree of confidence whether the law would meet fully the purposes of its enactment, the benefits which had resulted to the public and the utilities so far had been great and important, but the full benefits designed by the law, if attainable under it, could only be enjoyed in time to come.

Under the circumstances, the public, the utilities and the commission could well afford to labor together patiently and harmoniously, and, disregarding the clatter of the blatherskite and demagogue, to take each step cautiously, knowing that the achievement intended would redound to the material and moral welfare of society and, if successful, as it probably would be if confidence and patience were indulged, would be a credit to the State and a blessing to posterity.

Discussing the features of the law which he recognized as revolutionary in character, Mr. Roemer said that the duty of valuation imposed upon the commission was the gravest and most important of all its functions. There could be no escape from the conclusion that the value of every security of a public-service corporation in the State would be determined, and perhaps irrevocably fixed, by the appraisal made by the commission of the property of such corporation upon the credit of which such security was issued. While in time the conditions existing in some of the New England States, notably Massachusetts, where bonds of public-service corporations compete in a measure with public securities, may prevail in Wisconsin, Mr. Roemer thought that before such was likely to be the case, many, if not most, of the public utilities would have to undergo a financial regeneration.

The uniform system of accounting for public utilities had already demonstrated, Mr. Roemer declared, the wisdom of its adoption. While certain modifications might result, the principles upon which the system had been constructed, being in accord with the best thought and practice on the subject, would not be changed. Under the plan of accounting provided by the law and with the exercise of reasonable patience on the part of those charged with its execution, Mr. Roemer saw no reason why municipal plants might not be administered as efficiently and economically as those controlled by private capital.

Mr. Roemer described the work of the engineering staff under three heads: (1) valuation work; (2) service inspectional work, and (3) studies of operating conditions. The staff had just submitted to the commission an elaborate review of all available data touching upon the gas and electric service of the State with conclusions and recommendations drafted in the light of two years' experience under the public-utilities law. The studies of operating conditions promised far-reaching results when more fully developed. The commission had carefully guarded against assigning its staff to those lines of service which should properly be undertaken by the engineer in private practice.

In discussing the indeterminate permit for which provision is made in the Wisconsin law, Mr. Roemer said that the controlling reasons for the general failure of public-service corporations to surrender their municipal franchises and accept State permits seem to have been: (1) a doubt as to the legal right of the directors and stockholders to make the surrender without the consent of the bondholders whose mortgage security covers and includes the franchises of the corporation; (2) the practical impossibility of ascertaining all the bondholders and acquiring their consent, and (3) the erroneous, though perhaps not ill-founded, conception of the value of such franchises.

Mr. Roemer believes that the unbiased mind must necessarily come to the conclusion that the system of State regulation and aid provided by the public-utilities law of Wisconsin is capable of producing eventually more permanent and satisfactory results than any system of local control that can be conceived.

Amortization Rule of the New York Public Service Commission of the Second District.

Mr. George O. Bridgman, superintendent of the Board of Light Commissioners, of Boonville, N. Y., has filed a sworn statement with the New York Public Service Commission, Second District, concerning the treatment of the account "General Amortization—Electric." This statement says that the rule for the amortization of capital shall be to compute on the amount at which each subdivision of tangible capital was carried on the books as of Jan. 1, 1909, the percentages shown in the following:

PERCENTAGES.

	Per cent per annum.		Per cent per annum.
Land devoted to electric operations	0	Transmission system	1
Dam and flume	3	Distribution system	1
Power-plant buildings	2	Electric services	1
Turbines and water wheels	5	Electric meters	3
Electric generators	5	Municipal street lighting system	1
Accessory electric equipment	2	Line transformers	3
Substation buildings	2	Commercial arc lamps	5
Substation equipment	3	Electric tools and implements	5
Poles and fixtures	5	Laboratory equipment	10
		Other tangible capital	10

Mr. Bridgman says in his sworn statement, explaining the foregoing figures, that he has been superintendent of the Boonville plant since the commencement of operation on Jan. 1, 1904, and that he is familiar with the plant, its condition and the cost of maintenance and repair in each year of operation. Basing his opinion on such knowledge he prepared the rule for amortization upon the following basis:

"Land devoted to electrical operation," held in fee simple, is subject to no depreciation.

"Dam and flume" are of frame-timber construction, easily accessible for repair; estimated life, 35 years.

"Power-plant buildings" are on concrete foundation, the latter on rock; wood superstructures; slight repairs only required; estimated life, 50 years.

"Turbines and water-wheels" are McCormick longitudinal cylinder gate, controlled by No. 0 Lombard governor; estimated life, 20 years.

"Electric generators" are type A, G and B, 60-cycle General Electric Company alternating current running at 250 r.p.m. The alternator seems to be indestructible, the only repairs needed being on the exciter, belt-connected to the alternator; estimated life, 20 years.

"Accessory electric equipment" seems to be indestructible, except for nominal repairs; estimated life, 50 years.

"Substation buildings" condition the same as power-plant buildings.

"Substation equipment" needs but nominal repairs; estimated life, 35 years.

"Poles and fixtures." Poles are selected northern cedar, thoroughly set in heavy soil. Similar poles set in similar soil under observation after 20 years' service are still in good condition; estimated life, 20 years.

"Transmission system," "distribution system," "services" and "municipal street-lighting system" are all in similar condition. When wire requires replacement the salvage should be 80 per cent of original cost.

"Electric meters" require but slight repairs; estimated life, 35 years.

"Line transformers." Condition similar to meters; estimated life, 35 years.

"Commercial arc lamps" and "electric tools and implements"; estimated life, 20 years.

"Laboratory equipment" and "other tangible capital"; estimated life, 10 years.

In conclusion Mr. Bridgman says: "Computing the amortization as shown upon the various amounts of the above divisions of 'tangible capital' (exclusive of 'land devoted to electrical operation') amounts to a total sum of $1,468. The amortization averages approximately 2¼ per cent on the total amount. There is no 'intangible capital.'"

New York Public Service Commission News.

The Public Service Commission of the First District announces that all arrangements are practically made to begin work within a very short time on the Fourth Avenue subway in Brooklyn. All of the contractors who were awarded the work of construction have signified their intention to carry out their contracts, and William Bradley, who secured two of the most important sections, and Thomas E. Bryson, contractor for section five, have already perfected their contracts and offered their bonds. The other contractors will do this within a few days. It is believed by the commission that there will be practically no delay on account of securing the consents of property owners, and that work can begin at once.

Henry B. Seaman, chief engineer of the Public Service Commission of the First District, has filed a report recommending the proposed plans for a moving platform under Broadway. The proposition for the construction of this method of transit was made to the commission last February by the Continuous Transit Securities Company. Under the plans which have been submitted, it is proposed to build under Broadway, from Fourteenth Street north to Forty-second Street. The plan is to have a series of short units, forming an endless chain, which are kept in continuous motion. The platform is provided with seats and will travel at a speed of 12 miles an hour. To assure safety in getting on and off the 12-mile platform, there will be three loading platforms which will move at three, six and nine miles an hour respectively. Mr. Seaman is of the opinion that this mode of transit would be very serviceable for short trips.

There was some opposition developed in the Board of Estimate and Apportionment to the construction of an additional elevated line in the Bronx, as proposed by the resolutions sent to the board last week by the Public Service Commission. The matter was set for a hearing on Nov. 12.

The Public Service Commission, Second District, will give a hearing this week, at Port Jefferson, on the application of the North Shore Electric Light & Power Company asking permission to construct and operate an electric lighting plant at Port Jefferson, Suffolk County. At the present time there is an existing company furnishing light at Port Jefferson.

Canadian Hydroelectric Commission News.

The struggle between the opposing forces in Hamilton, Ont., for and against the city making a contract for electric power with the commission, mention of which has been made in these columns, was renewed at a meeting of the City Council on Monday, Nov. 1, and after a long debate, lasting over three hours, the Aldermen were evenly divided and it took the casting vote of the Mayor to carry an amendment putting over the proposed contract for 1000 hp in order to obtain further concessions from the commission. The special committee reported that "the question of entering into a contract at the present time with the Hydroelectric Commission for a supply of power having been approved by vote of the ratepayers, the committee recommends that the city apply to the commission for a supply of 1000 hp on the terms and conditions set forth in the said contract, upon the understanding that the $8,523 mentioned in the schedule of the contract includes sinking fund and interest, as well as line loss and other operating expenses."

An amendment was moved to the effect that the city should apply for the 1000 hp and, while not being bound to take power exclusively from the commission as other municipalities are, that the city should have all the rights enjoyed by the other municipalities.

The amendment carried with the casting vote of the Mayor.

On Nov. 4, the ratepayers of Port Arthur, Ontario, by a vote in the proportion of almost three to one, endorsed the acceptance of an agreement made by the city with the Hydroelectric Commission for a supply of electric power for the town. The agreement calls for delivery of 24-hour power at a sliding scale, beginning with $22.10, per annual horse-power, for a block of 1000 hp and running down to $17.65 for 5000 hp, this price not including interest on capital invested nor sinking fund. Strong opposition was suddenly developed against the proposition by James Conmee, acting for the Ontario & Michigan Power Company, who submitted three alternative proposals. After the result of the voting became known, notice of application for an injunction was served on the city seeking to prevent the signing of the agreement with the commission.

Hon. Adam Beck, chairman of the commission, who was in the city on the night of the voting, stated that the commission would forthwith let the contracts for the local transformer station building and its equipment at an estimated cost of $60,000. The commission had concluded a contract with the Kaministiquia Power Company on a principle similar to the contract with the Ontario Power Company in the Niagara district, under which power will be supplied at a sliding scale of $17 per annual horse-power in blocks of 1000 and running to $14 ultimately for the largest block. Mr. Beck also showed that Fort William, sister city to Port Arthur, would similarly benefit to the extent of about $30,000 per year, as that city has a contract which provides for a similar reduction in price in the event of lower rates being granted to other consumers of the Power Company.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued a decision permitting the Connecticut River Transmission Company to enter the power field in the city of Worcester on the same principal limitations of demand and consumption as were laid down by the board in the recent appeal of the Fitchburg Gas & Electric Light Company against the Transmission Company. The Worcester Electric Light Company appealed to the board against a franchise granted the Transmission Company last May for locations and the right to sell electricity in Worcester to consumers of 15-hp rating and upward, with a minimum annual consumption of 22,500 hp-hours. A hearing was held by the board at the Worcester City Hall and arguments heard along substantially the same lines that were followed in the Fitchburg case.

The Worcester company offered practically no objection to the entrance of the Transmission company if the Fitchburg limitations should apply, and the latter confessed itself willing to abide by these limits. The municipal authorities of Worcester, however, desired a lower limit than was established in the Fitchburg case, and the hearing was carried forward on the basis of making clear to the city the reasons why the small power business should remain in the hands of the local company. In its decision the board repeats the Fitchburg limitations, which are that the Transmission company may sell power to consumers having a total connected load of not less than 300 hp, and an annual consumption of not less than 450,000 hp-hours. The board says in part:

"It is extremely doubtful whether the Transmission company can undertake to give the same advantages to both small and large users of power, and, on the other hand, it is equally doubtful if the Worcester company is likely to be in a position to profitably undertake to supply large power users. For this reason, and in the interest of the small user, the Transmission company should be willing to sell to the Worcester company, which in turn should be willing to buy all the power which the former may have available for the purpose and be willing to sell at a less price than the latter company can make it. To avoid the disadvantages necessarily incident to duplicate systems of distribution both companies may reasonably be required upon such terms and conditions as are equitable, to combine their lines, and while operating independently otherwise, to serve respectively the large and the small users of power.

"It is doubtful if any fixed rule can be laid down or exact lines drawn for the division between large and small users of power. Changes in local conditions may impose changes in the business of the company and the community. The limits and conditions under which power should in the public interest be

supplied by this company may be determined only by experience. The board finds no conditions in the Worcester case which tend to establish a different limit than that used in the Fitchburg case."

The board has, therefore, issued a decree granting the Transmission company the right to sell power in Worcester to consumers of the 300-hp class and to sell to the Worcester Electric Light Company. The limited franchise granted by the authorities is set aside in favor of an indeterminate franchise.

The Massachusetts Gas and Electric Light Commission has issued a decision under date of Nov. 4, upon the complaint of the Selectmen of Leominster that the Leominster Electric Light & Power Company has disregarded the recommendation of the board made on May 29 relative to the price of electricity supplied by the company. On the latter date the board recommended that on and after June 1, 1909, the net price charged by the company for electricity should not exceed 16 cents per kw-hour. The Selectmen complained that, notwithstanding the board's action, the company continues to charge customers for light and power certain fixed or minimum rates, so that the customers have no benefit from the order, but are charged more than 16 cents per kw-hour.

The commission states in part: "On June 1 the company discontinued the schedules of prices for commercial lighting theretofore prevailing and adopted a gross price of 18 cents per kw-hour, with a discount of 2 cents per kw-hour for prompt payment and a minimum monthly charge of $1. No change was made in the power rates which are set out in detail in the board's decision and include a monthly service charge based upon the horse-power of the consumer's motor, independent of and in addition to the charge for the current consumed. Under it a power customer has no choice between paying the service charge or the maximum net price of 16 cents, but must pay the service charge and the kw-hour price if he desires to use electricity for power.

"During the hearings in the original case there was no complaint of the minimum monthly charge of $1 made to the lighting customers. A charge of this character is a common feature of electric light schedules. It is not a service charge or meter rent imposed in addition to the actual charge for energy.

"The board, therefore, recommends, in furtherance of its decision of May 29, 1909, that the company immediately offer to sell electricity for any use at a net price not to exceed 16 cents per kw-hour with such minimum monthly charge not exceeding $1 per month as it is now employing with respect to its lighting customers; that the company adjust with its customers, who elect to be served at the rate fixed by the board, any excess actually charged them over and above the amount which they would have been charged had the foregoing recommendation been put in force on June 1, 1909; that if a customer elects to be served under such other schedules for lighting or power as are now or may hereafter be in force, whenever the charges for such service for any year thereunder aggregate more than 16 cents per kw-hour for the electricity so supplied to him, the company shall restore to him such excess; and that the company, shall, as promptly as is consistent with the fulfillment of current contracts, if any exist, discontinue giving or offering any advantage to one customer not open to all who enjoy or seek the company's service under like conditions."

The Massachusetts Gas and Electric Light Commission gave a public hearing on Nov. 5 upon the petition of the Edison Electric Illuminating Company, of Boston, for authority to issue 19,452 shares of capital stock at $215 each, in connection with the purchase of the suburban electric lighting companies in Newton, Waltham, Brookline and Chelsea, approved by the board on Aug. 20, 1909. The case for the company was conducted by its general counsel, Mr. Everett W. Burdett, of Boston. He stated that the Edison company desires to capitalize these properties at their full value, as indicated by the purchase price, issuing the stock to its own stockholders and not to the former owners of the properties. There has been expended for the purchase of these properties, $2,750,000, but to complete the transaction there would be a total capitalizable liability on Dec. 31, 1909, of $4,355,963.79. The chief question at the hearing was whether there is any reason why the fair value of the properties should not be capitalized.

The Railroad and Transit Commissions, sitting jointly, gave a hearing Nov. 4 on the proposition of J. F. Cronin and others that a subway be built under Washington Street in place of the present elevated structure of the Boston Elevated Railway Company, between Castle and Dudley Streets. The scheme was denounced as impracticable by Corporation Counsel Babson, who emphasized the permanent rights of the company in Washington Street, through legislative sanction, and who condemned the financial aspects of the project, even if legally possible. Counsel F. E. Snow, for the Boston Elevated Railway Company, urged the unconstitutionality of the proposed measure, and emphasized the approval of the public authorities of the details of the structure at the time it was erected. The commission will report its finding to the Legislature of 1910, in connection with the consideration of other transportation questions in the Boston district.

The Gas and Electric Light Commission issued an order Nov. 8 approving the issue of new capital stock by the Brockton Gas Light Company to the par value of $59,000, the proceeds to be applied to payments on account of plant additions.

CURRENT NEWS AND NOTES.

MARYLAND INDEPENDENT TELEPHONE SYSTEM SOLD TO BELL COMPANY.—The Chesapeake & Potomac Telephone Company has purchased the Frederick County Telephone Company, which heretofore has been in competition with the Bell Company.

A. I. E. E. NEW YORK MEETING.—At a meeting of the American Institute of Electrical Engineers to be held in the Engineering Societies Building, New York, on Nov. 12, a paper entitled "The Electric System of the Great Northern Railway Company at Cascade Tunnel" will be presented by Dr. Cary T. Hutchinson.

ELECTRIC VS. GAS METERS.—The report of the New York City Public Service Commission for October on tests of gas and electric meters shows that of meters tested on complaint, 40.8 per cent of the gas meters were fast and 9.5 per cent slow; of the electric meters only 3.4 per cent were fast while 6.9 per cent were slow.

FUEL TESTS.—"Fuel Tests with Illinois Coal," by L. P. Breckenridge and Paul Diserens, is the title of Circular No. 3 just issued by the Engineering Experiment Station of the University of Illinois. It consists of a compilation of data relating solely to the coals of the State of Illinois, selected from the complete reports of the Government investigations on the fuels of the United States.

MADISON (WIS.) OVERHEAD LINE ORDINANCE.—The street committee on the Madison City Council has taken favorable action of an ordinance which provides that all telegraph, telephone and electric light poles and wires shall be removed from State Street, a thoroughfare nine blocks long, within six months after the ordinance's passage. The Wisconsin Telephone Company operates in this city. The ordinance also provides that the Southern Wisconsin Railway Company erect iron trolley poles on this street. Action will be taken Nov. 12.

SPECIAL LIBRARIES ASSOCIATION.—The first annual meeting of the Special Libraries Association was held in New York, Nov. 5, with a large attendance. The object of the association is to bring about specialization so far as possible by present libraries, and the creation of libraries in large centers making a specialty of a branch of knowledge. Public Service Commissioner Maltbie made a plea for the establishment in New York City of a library devoted to municipal matters. Engineering was not represented on the program nor in the proceedings.

ELECTRIC VS. NAVIGATION RIGHTS ON CAPE FEAR RIVER.—Vessel owners have filed a complaint at Washington against the Carolina Electric Power Company on the grounds that it renders navigation on Cape Fear River impossible at stated periods each 24 hours.

ACCURACY OF WATT-HOUR METERS.—The New York Public Service Commission's Bureau of Gas and Electricity has reported that of 29 watt-hour meters tested upon complaint in October only one was passed by more than the legal rate of 4 per cent.

ILLUMINATION OF DENVER AUDITORIUM.—A trial installation is being made of an outlining lighting scheme for the Denver Auditorium. Some 10,000 low candle-power lamps will be so arranged as to emphasize the architectural features of the building. If the trial proves satisfactory to the city authorities they will authorize the permanent installation of a decorative lighting system along similar lines in conduit.

BALTIMORE ELECTRIC SIGN TAX.—The law officer of Baltimore has decided that while an existing ordinance imposing a license fee on signs is illegal so far as it applies to ordinary signs, it must be enforced with respect to electric signs. As a consequence a tax of $5 per year is now collected from owners if a sign projects less than 2 ft. over the building line, or $10 if it projects more than 2 ft.

ILLUMINATING ENGINEERING.—At the meeting of the New York Section of the Illuminating Engineering Society, to be held on Nov. 11, the subject of division of membership of the society will be discussed, together with the topics "What is an Illuminating Engineer?" and "What Qualifications Should a Person Possess Before He is Entitled to Assume the Title of Illuminating Engineer?"

LONG-DISTANCE WIRELESS.—According to reports from San Francisco, the long-distance transmission of wireless messages by the steamship *Minnesota,* mentioned in our issue for Nov. 4, has been surpassed to the extent of several hundred miles by a transmission over a distance of 4720 miles by the steamship *Korea.* This vessel was equipped with apparatus rated at only 5 kw and provided with an antenna less than 100 ft. in height.

NEW MEXICO HYDROELECTRIC PLANT.—One of the largest power projects ever started in New Mexico is under way at High Rolls, near Alamogordo, where the Alamogordo Water Power Company is building a plant which will utilize the water from a mountain stream through pipe line to generator of 5000 hp for furnishing the towns of Alamogordo and Tularosa with light and power. Power will also be supplied for irrigation pumping plants all through Tularosa Valley.

AWARD OF A. I. E. E. EDISON MEDAL.—We are informed by the University of Illinois that Mr. Trygve Jensen, a graduate of the department of electrical engineering of that university, has recently been awarded the prize offered by the Edison medal committee of the American Institute of Electrical Engineers for the best thesis presented in competition under the conditions specified by the committee. The title of Mr. Jensen's thesis is "The Operation of a 100,000-volt Transformer." The prize consists of a diploma and a cash award of $150.

PREVENTION OF INDUSTRIAL ACCIDENTS.—The Fidelity & Casualty Company, New York, has issued a 200-page book in paper covers which deals with the prevention of industrial accidents in general. Ten pages with the heading "Electrical Apparatus" contain precautions for the avoidance of danger from electric shock. We note that the grounding of alternating-current secondaries up to 250 volts is urged. The present publication will be followed by others dealing singly with specific industries. The work is excellently compiled and reflects credit on the editors, Messrs. Frank E. Law and William Newell, of the Fidelity Company.

PROPOSED ABSORPTION OF CENTRAL-STATION PROPERTY BY JAMESTOWN (N. Y.) MUNICIPALITY.—By a vote of 11 to 1 the Common Council of Jamestown, N. Y., decided on Nov. 1 to call a special election for Nov. 20 to let the taxpayers decide whether they want to buy the franchise and property of the Jamestown Light & Power Company and consolidate them with the municipal plant at a total cost of $120,000, $90,000 for the property and $30,000 to consolidate the two plants. The details of this unusual proposal that an American municipality obtain a monopoly of electric service by buying out its private-owned rival in the commercial light and power business were given in *Electrical World* of Oct. 28, page 1020.

TO SMOKE OR NOT TO SMOKE.—As previously announced, smoking cars have been abolished on the Chicago & Oak Park Elevated Railroad. Men accustomed to smoking on the train view the change with entire disfavor, and the company has experienced considerable trouble in enforcing the order. A number of men passengers in the car, which would have been the smoking-car under the old order, have persisted in smoking despite the conductor's warnings and commands. Ejections and arrests have followed. Signs announcing the change have been torn down, and indignation meetings are threatened. Women passengers are still rather dubious about entering former smoking-cars, which have been treated with oil of sassafras, it is said, to remove the odor of tobacco smoke. One expedient of conductors to subjugate smokers is to hold a train at a station until the offenders put away their cigars or pipes, at least temporarily.

BRITISH WELSBACH LAMP LITIGATION.—The entry of the British Welsbach Gas Company into the lighting field with an electric lamp, previously noted in these columns, has now become a subject of litigation. The gas company has been haled into court by an electric lamp company which manufactures tungsten lamps under rights acquired from the German company which owns the patents of Baron Welsbach on electric lighting. The charge is made that while Welsbach invented the osmium metallic-filament lamp, he has not invented a tungsten lamp; and that the advertisements of the gas concern are so written as to convey a contrary impression, to the injury of the interests of the English company making tungsten lamps under rights acquired from the German company, which manufactures tungsten lamps not invented by Welsbach, and owns the patents of a Welsbach metallic-filament lamp which are not manufactured.

COMMONWEALTH EDISON EMPLOYEES' SAVING FUND.—The offer of the directors of the Commonwealth Edison Company to receive savings from employees, operative July 1 last and heretofore outlined in this journal, is appreciated by the employees, as shown by the fact that about 50 per cent of them have taken advantage of it. Employees may subscribe 3 or 5 per cent of their salaries. The subscription period is for five years, or until the subscriber leaves the company or is discharged. At the end of the period the subscriber or his estate will receive back all money paid in with interest compounded semi-annually at 6 per cent. If the subscription period continues for the full five years, the subscriber may, at his election, receive, instead of cash, as much of the company's capital stock as the amount of his principal and interest will then purchase at par if the stock is then selling at or above par, or at the average market price during the two preceding months if the stock is then selling below par. If the stock is than selling at about 120, as at present, this arrangement will net the employee a return of about 16 per cent.

DR. STEINMETZ'S CHICAGO LECTURE.—The date of Dr. C. P. Steinmetz's forthcoming lecture in Chicago has been definitely fixed for Nov. 16. Dr. Steinmetz will speak in Fullerton Hall, Art Institute, before a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. His subject will be "The Conservation of Energy."

NEW POWER PLANT FOR UNIVERSITY OF ILLINOIS.—The University of Illinois will begin construction at once of a new power plant, arrangements for which are in charge of a committee consisting of Mr. W. L. Abbott, of the board of trustees; Prof. W. F. M. Goss, dean of the College of Engineering, and Prof. James M. White, supervising architect, of the university. Mr. W. H. Zimmerman, of Lansing, Mich., is consulting engineer for the plant.

NORMALLY UNNAVIGABLE STREAM.—In the account given last week of the important decision permitting a dam to be erected in the Desplaines River, the word "unnavigable" instead of "navigable" should have appeared in the head. The whole case, as indicated in the article, turned on the navigability of the stream, and the court upheld the contention of the Economy Light & Power Company that as it was navigable in its original state when the riparian rights were acquired, the right to erect a dam could not be successfully contested.

TUNGSTEN ORES.—The U. S. Geological Survey reports that in 1908 the domestic production of tungsten ore, reduced to an equivalent of ore carrying 60 per cent of tungstic trioxide, the ordinary commercial basis in the United States, was 671 short tons, valued at $229,955, as against 1640 tons, valued at $890,048, in 1907. The statistics at present available from foreign countries show a similar decline. By far the largest part of the tungsten produced is used in making tool steel.

FISK STREET A WINTER PORT.—Fisk Street station of the Commonwealth Edison Company, Chicago, lies on the South Branch of the Chicago River, and for several years Mason's Slip, just east of the property, has been the winter quarters of yachts and other craft in which electrical men are interested. A number of the Edison "boys" are members of the Illinois Naval Militia, and the U. S. steamship *Nashville* is tied up at Fisk Street for the entire winter. Other boats in the slip are Mr. E. C. Noe's 65-ft. gasoline launch *Diana*, Mr. G. H. Atkin's 45-ft. schooner *Nomad* and Dr. W. L. Baum's 90-ft. schooner *Amorita*.

NEW TELEGRAPH LINES AT PANAMA.—A contract has been entered into between the Panama Railroad Company and the Republic of Panama, providing for the construction and maintenance of a telegraph line between Panama and Colon and between Panama and Empire. Each line consists of two No. 10 copper wires, to be erected and maintained by the railroad company for the use of the Panama Government, and it is agreed that no message shall be transmitted by the Government over these lines at a rate lower than that charged by the railroad company. The Government is prohibited from doing a telephone business over the new circuits. The existing telegraph rate of 25 cents for a 10-word message, with 2 cents for each additional word, is to be maintained.

DENVER STEAM-TURBINE ACCIDENT.—On Saturday evening, Oct. 30, at 6 o'clock, the west side plant of the Denver Gas & Electric Company was shut down by the short-circuiting and consequent burning out of the 2000-kw steam-turbine unit. The station was at the time running at its full capacity and the disconnection of this unit caused the shut-down over the entire system, which, because of the testing necessary before putting back the generators on the line and the necessity for phasing in the power derived from the Central Colorado Power Company's substation, caused Denver to be without lighting service for some 35 minutes. This is the second burn-out of this machine within a year, the former occurring at a time when the accident did not cause such serious consequences.

"PLAN OF CHICAGO."—Mayor Busse has appointed a commission consisting of more than 300 citizens of Chicago, to study the elaborate "Plan of Chicago" presented by the Commercial Club of Chicago for the systematic improvement and beautifying of the city. This plan, which has been briefly described in these columns, represented three years' work and an expenditure of about $100,000. The commission is intended to represent every section of the city and every element in the population. It contains very few distinctly electrical men, however, about the only one being Mr. Bernard E. Sunny, president of the Chicago Telephone Company. Other members are Mr. Charles G. Dawes, connected with the central-station interests; Mr. George W. Jackson, the constructing engineer, and Mr. Robert T. Lincoln, first vice-president of the Commonwealth Edison Company.

PROPOSED MONTREAL MUNICIPAL PLANT.—The Montreal City Council took another step on Nov. 2 toward the establishment of a municipal lighting plant by giving a by-law the second reading providing for the raising of about $2,000,000 for a term of 40 years at 4 per cent. The city was authorized by the Legislature at the last session to undertake the manufacture of electric light out of garbage refuse, and the by-law as now prepared authorizes the city to erect, purchase or acquire and operate works for the production of electricity by means of the incineration of garbage, or water-power, or by means of coal. In the meantime, pending the completion of the city's plans for the construction of its own plant, the Council has decided, after much discussion and delay, to offer to the Montreal Light, Heat & Power Company the price of $75 per arc lamp per annum for a period of five years.

A LONG-FOUGHT ELECTRICAL ACCIDENT CASE.—After being fought for years through every Canadian court up to the Imperial Privy Council in England, then sent back to Canada for a new trial and appealed once more to the Court of Appeal, the latter court on Nov. 2 gave a decision in a case claiming damages for the death of a husband from electric shock. After a long course of litigation against the Montreal Light, Heat & Power Company, the case went back to the Superior Court, this time against the C. Martineau Company, the contractors who owned the derrick which caused the fatality, and the jury there found the Martineau company responsible for Curtis' death, when a verdict for $3,000 damages was rendered in Mrs. Curtis' favor against the Martineau company; the latter then appealed to the Court of Appeals, which confirmed that judgment. As it now stands the Martineau company has 15 days in which to serve notice of appeal to the Supreme Court or direct to the Imperial Privy Council. Curtis was killed nearly five years ago by contact with a live wire at Point St. Charles. Construction work was being carried on there by the C. Martineau Company, when a derrick chain swung against a power wire killing the man at the chain. Another man went to his assistance and was stunned by the current through the first man's body. Then Curtis went to assist the second man and in turn was killed by the current passing through his body, although the second man was merely temporarily stunned. Mrs. Curtis then entered action against the Montreal Light, Heat & Power Company. The first jury exonerated the Martineau firm, and the fight as to the liability of the power company was carried to the Privy Council in England, where the company won, it being shown that its charter entitled it to string live wires as it had done. The whole matter as to the responsibility of the Martineau firm was referred back to the Canadian courts and fought to the Supreme Court, where a new trial was ordered. On this being heard in Montreal the jury gave judgment against the Martineau company for $3,000 damages, which the Court of Appeal has now sustained.

An Oil-Engine Central Station.

AN interesting example of the utility of electrical service in a prosperous industrial community of moderate size is afforded by the district centering about the town of Westerly, R. I. Westerly has a population of about 9000 inhabitants throughout the year; it is located in a region well supplied with granite quarries, and is situated on the shore line of the New York, New Haven & Hartford Railroad between Boston and New York, having excellent shipping facilities and passenger-train service. A number of textile manufactories are located in the town, with a variety of other industries of diversified power requirements. The generation, transmission and distribution of electricity throughout the district is handled by the Westerly Light & Power Company, under the general management of H. B. Rust & Company, of Providence, R. I., Mr. M. H. Spellman having immediate charge of the administration of the property as local manager with headquarters at Westerly.

The present property is the result of a consolidation of five old and weak companies which formerly attempted to occupy the field, and the service supplied extends radially from Westerly to points from five to ten miles distant, a considerable part of the business being in the bordering State of Connecticut. The present management was established about three years ago, and at that time the territory was wholly unexploited in a commercial way, there being practically no motor load whatever and a commercial lighting business of indifferent character. Under the present management the connected motor load has advanced from nothing to over 400 hp; the street lighting has been modernized throughout the territory now covered; commercial lighting customers have been afforded the use of the most improved equipment; inefficient generating equipment has given place to an economical plant supplying energy throughout the entire territory; transmission lines have been co-ordinated into a comprehensive system with control of the service at modern transformer stations and at the main generating station; and the earnings of the district have been increased nearly 30 per cent and operating expenses reduced 6.5 per cent. The actual cash collections from the sale of energy for lamps and motors increased from $66,547 in the year ending Aug. 31, 1907, to $85,390 in 1909; actual operating expenses, including taxes, were $45,603 in 1907 and $42,562 in 1909, including all repairs and maintenance. Bond interest each year remained stationary at $18,700. The surplus for 1907, taking into account all income, was $2,245 and for 1909 $25,600. The company feels that it has only fairly begun to tap the motor business in the territory, and is now making active efforts to secure the motor business of the principal quarries of the district. The present motor load centers among

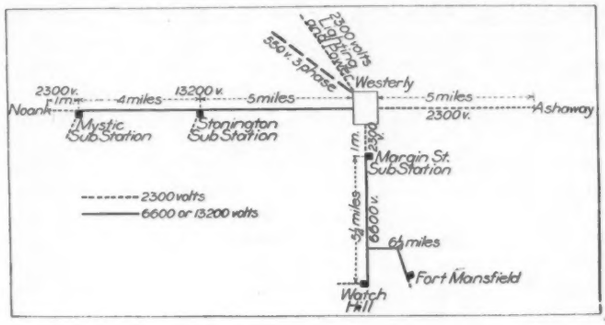


FIG. 1.—SKETCH OF WESTERLY TRANSMISSION SYSTEM.

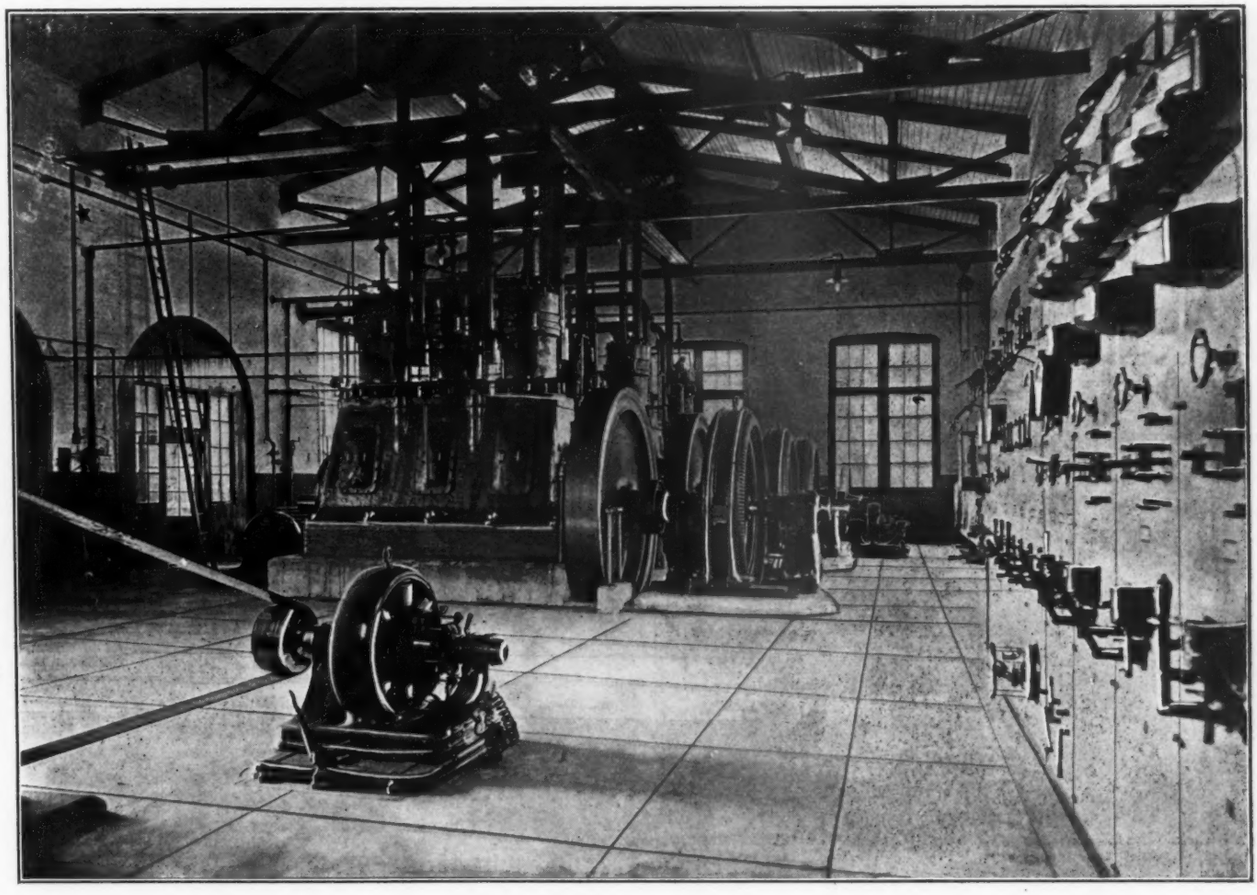


FIG. 2.—VIEW OF INTERIOR OF WESTERLY OIL-ENGINE PLANT.

the stone sheds and miscellaneous industries, and the prospects are excellent for the wider introduction of the motor drive in the company's field.

The main offices of the company are located at Westerly, but the financial administration is directed from Providence. At the Westerly offices the local accounts are handled, and the local manager has his headquarters, a small display space being in use here, with stockroom facilities and a repair bench for meter testing. The exhibit consists of modern energy-consuming equipment of the small-power type, including vacuum cleaners, vibrators, electric heating apparatus and other appurtenances. The apparatus is displayed in a commodious window on the street level in the central part of the business district of Westerly, and the window is wired for 110 volts alternating-current service, so that any equipment can be demonstrated at sight before prospective customers. The offices are provided with both local, automatic and long-distance telephone service by the lines of the Providence Telephone Company. In connection with the commercial work of the company, advertisements are carried in the local press, these being changed frequently to meet the conditions.

The company supplies electricity to Westerly, Watch Hill, Richmond and Ashaway, in Rhode Island, and to Stonington, Pawcatuck, Mystic and Noank, and Groton, in Connecticut. Outside of Westerly the principal center reached is Mystic, which has a population of about 5000. The total population served is about 25,000. At Watch Hill a considerable summer business is developing.

A diagram of the company's transmission system is shown on page 1163. The lines are all radial from the power house in Westerly, three different voltages being used, according to the distance of the various load centers from the station. Stonington, Mystic and Noank are supplied with energy by a three-phase, 13,200-volt line of No. 4 copper, B. & S., Stonington being five miles from the Westerly station and Mystic four miles beyond Stonington. From Mystic the service to Noank is effected by a three-phase, 2300-volt line of No. 6 copper, the distance being about one mile. Another line runs southward from Westerly to Watch Hill and Fort Mansfield. The first three-fourths mile is of No. 4, 2300-volt, three-phase service, terminating at a substation on Margin Street, Westerly, where the company has a temporary auxiliary installation of 160-kw

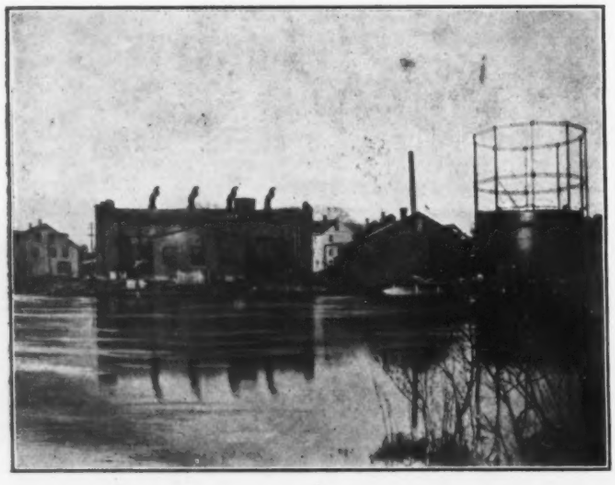


FIG. 3.—VIEW OF EXTERIOR OF PLANT FROM CONNECTICUT SHORE.

generating equipment driven by steam engines. The Margin Street substation is owned by the Norwich & Westerly Street Railway Company, this being the generating plant for the local traction service. At Margin Street are installed transformers which raise the voltage to 6600 for transmission to Watch Hill and Fort Mansfield. The line runs direct to Watch Hill, 5.25 miles, with a branch outside Watch Hill to Fort Mansfield, the distance to the fort from Margin Street being 6.25 miles. No. 4 copper is used for all this service. There are also a No. 6, three-phase, 2300-volt line five miles long from Westerly to Ashaway, and several 2300-volt circuits in the Westerly district delivering energy to commercial customers and taking care of the street illumination.

The street lighting of the company's territory is effected mainly by the use of series tungsten lamps of 32 cp and 40 cp, each taking 5.5 amp. In general, the lamps are installed 16 ft.

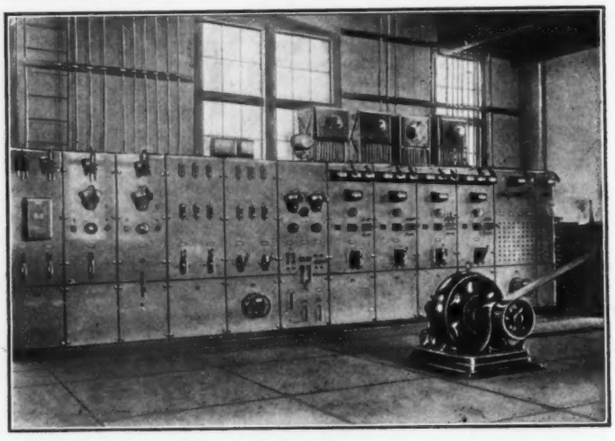


FIG. 4.—VIEW OF SWITCHBOARD.

above the streets and are equipped with Wheeler reflectors. All-night and every-night service is given in the towns. Westerly is served by 290 lamps, Watch Hill by 120, Pawcatuck by 133 40-cp tungstens; and Stonington, Mystic and Noank by 72, 145 and 32 32-cp incandescents, respectively. The company receives $15 per year each for the 32-cp lamps and $18 for the 40-cp units. In each case the contracts call for only 25 cp and 32 cp, respectively, so that under the present management the different towns are getting from 25 to 28 per cent more light for the same money than when carbon lamps were used in the street-lighting service. Westerly is supplied with 35 6.6-amp arc lamps of the series alternating-current type, mounted 21 ft. above the street, and there are three of these lamps in Pawcatuck, on the opposite side of the river from the Westerly station. A satisfactory street illumination in Westerly has been accomplished in one instance by the use of a cluster of three series tungsten lamps of 5.5-amp rating, 50 watts each, located 21 ft. above the street, on a corner where an arc lamp would have given too much illumination and a single tungsten lamp too little.

The power house at Westerly contains a Diesel oil-engine equipment, having a present rating of 640 kw, installed in four similar units of the revolving-field, direct-connected type. The plant is located on the north bank of the Pawcatuck River in the center of Westerly, and the gas generating and storing plants of the company are situated on the same area. The building is a one-story brick structure with granite trimmings, and it consists of an engine-room, 80 ft. long by 43 ft. wide, and a compressor-room, 30 ft. long by 17 ft. wide, with an overhead transformer gallery in the engine-room and oil-storage facilities under the ground outside the station building. A slightly sloping tar-and-gravel roof is carried on a steel-truss framework. Three of the four units are grouped close together, a space being left between the third and fourth units for the installation of a new engine and generator in the immediate future. Each of the present generating units consists of a 160-kw, three-phase, 2300-volt Fort Wayne alternator directly driven by a three-cylinder 16-in. x 24-in. American Diesel oil engine running at 164 r.p.m. The engines burn crude oil costing about 2.9 cents per gallon. The oil is stored in a tank of 10,000-gal. rating mounted on a concrete base 8 ft. thick and set with the top of the tank about 4 ft. below the surface of the ground. The tank is of sheet-iron construction, 28 ft. long and 8 ft. in diameter, and is equipped with about 50

ft. of 1-in. steam pipe from the boiler of the gas plant to enable operation to be carried on in the coldest weather without danger of freezing. Steam at 120 lb. pressure is turned into this pipe coil whenever the weather requires. The tank is supplied with oil by a pipe connecting with a nozzle-and-valve stand beside a spur track of the New York, New Haven & Hartford Railroad, which permits gravity delivery from tank cars. The railroad siding is about 200 ft. away from the power house, and the oil-supply pipe is carried in a wooden-box conduit with a 1-in. steam line to prevent freezing. The cost of handling the oil is thus reduced to a minimum. From the tank in the yard, which is covered with grass to form a parked approach to the station, a 1.25-in. pipe is run to a hand pump in the compressor-room, and from here the oil is pumped into a 75-gal. tank located in the upper part of the room so that delivery can be effected by gravity to the engine cylinders. Each engine is supplied through a 1-in. pipe leading to the cylinders from the smaller tank. A float and index are provided so that the oil can be kept at the proper level without difficulty. On a recent day's run, Oct. 15, the station generated 5340 kw-hours and consumed 555 gal. of fuel oil, the unit consumption being 9.6 kw-hours per gallon. There were also required on this day 2 qt. of engine oil, 2 qt. of crank-case oil, and ⅛ qt. of compressor oil. Unit No. 1 ran 20.5 hours; unit 3 ran 6.4 hours; unit 4 ran 22.45 hours, and unit 5 ran 7.1 hours. Unit 2 is not yet installed.

Cooling water for the engines is supplied by the Pawcatuck River. Two 2-in. pipes are carried from the river into a well outside the station and thence pumped through the circulating

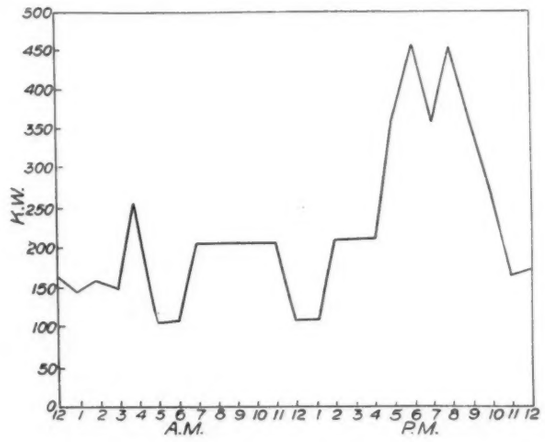


FIG. 5.—WESTERLY LOAD CURVE, OCT. 15, 1909.

system. The well is about 6 ft. long, 5 ft. wide and 10 ft. deep, the average depth of water being 6 ft. Beyond the pumps the two supply pipes are joined in a 3-in. main from which lateral branches 1.5 in. in diameter are taken off for the supply of each engine. The heated water is discharged from each cylinder by 1.5-in. pipe, and the drains are then collected in a 6-in. trunk line which is turned to the river below the suction lines mentioned above. All these lines are suitably valved so that different sections can be cut in or out at the will of the operating engineers. The engine exhausts are collected in a water muffler outside the station, and the operation of the plant is practically noiseless. Above each engine an I-beam is installed, with a traveling tackle to facilitate the removal of any part of the machine when necessary.

The compressor-room contains three 8-in. x 8-in. three-stage Norwalk air compressors, each directly driven by a 25-hp Fort Wayne 550-volt induction motor, and supplying air to the engine cylinders and to 14 steel tanks used for storage and starting up the plant in case of a shutdown. The compressors deliver air at 1200 lb. per square inch for use in the usual Diesel cycle. In case the plant should be completely shut down and the bottles empty, compressor gas can be obtained from a soda-water carbonating plant in the immediate neighborhood. The compressor-room also contains the water-circulating pumps, which are two in number and of the Douglass type, with split shells and centrifugal action. Each is directly connected to a 2-hp induction motor of Fort Wayne make, mounted on a horizontal shaft conection with the pump in each case. Under normal conditions an engine can be started from a cold state in about two minutes.

The engine interiors are inspected on alternate days, special attention being given to the bearings and crank-pin boxes. The valves are reground every two weeks, if necessary, and a general overhauling is carried out once a year. The plunger packing on all engine pumps is renewed every six weeks. Needle valves are withdrawn and atomizers inspected every fortnight. The compressor valves are withdrawn and cleaned weekly, and soap and water are fed through the lubricator on each compressor weekly, for one hour at a time. The engines are put in the starting position when stopped.

A new type of oil-burning engine will shortly be installed in the plant at Westerly, according to the designs of Mr. George F. Murphy, of the Fuel Oil Engine Company, of Providence, R. I., and formerly with the American Diesel Engine Company, New York. The engine is equipped with two cylinders 18 in. in diameter by 28-in. stroke, and is to be operated at a normal speed of 165 r.p.m. It is to be of the double-acting, two-stroke-cycle type, with ignition by compression, as in the Diesel engine, but is to be built with a horizontal Tangye open frame and equipped with Corliss valve gear. The exhaust and air inlet ports are cast in the center of the cylinder and are covered and uncovered by the piston, thus eliminating any form of poppet valve. All the working parts are exposed to the full view of the operating engineer, and any part can be removed and repaired without disturbing any other. In operation the engine will compress to about 500 lb. per square inch, starting on air, as with the Diesel engine. The engine is provided with a front and a rear cross-head, and these are adjusted so that the piston is kept floating, thereby eliminating the possibility of cylinder wear and the necessity for reboring the cylinders. Water circulation will be provided through the piston and the piston rod. The crankshaft is built in one straight piece to avoid breakage. The governor is of the enclosed Jahns type, and the speed regulation is designed to permit the operation of alternating-current generators in parallel. The engine will use the heaviest grades of crude oil, and it is expected that it will show good operating results on oil of a specific gravity as high as 10 Baumé. The presence of sulphur or acidulous matter in the oil is expected to cause no trouble in operation, and the anticipated consumption is less than 8 gal. of crude oil per 100 hp-hours. The engine is now being set up at the works of the builders, and will be directly connected to the alternator now at the Margin Street substation, and installed in the main power house at Westerly.

The exciter equipment of the plant comprises two 15-kw belted units and a 35-kw generator driven by a directly coupled induction motor. The machines are excited at 125 volts. The switchboard at Westerly contains nine blue Vermont marble panels, with a central section devoted to generator busbars and switches, and on each side of the generators a section devoted to motor and commercial lamp loads and to street lighting. A totalizing watt-hour meter is installed on each side of the generator section, and these meters are read hourly throughout the entire day and night. Mounted on a gallery above the east end of the engine-room are the transformers for street lighting and transmission service. These include three 100-kw, oil-cooled Fort Wayne units for raising the potential from 2300 volts to 13,200 volts for transmission to Stonington and Mystic; three 100-kw, 6600-volt transformers for the Watch Hill line, and three tub transformers aggregating 75 kw, two being used for incandescent service and the third for arc lighting in Westerly.

The line construction embodies the use of chestnut poles with a minimum length of 30 ft., six-pin cross-arms and insulators of porcelain and glass designed for operation at 20,000 volts. There is no underground construction on the system.

The various centers of load on the system are supplied with energy through step-down transformer substations without the use of rotating machinery of any kind, which arrangement minimizes the attendance necessary. At Watch Hill two 75-kw transformers handle the service; at Fort Mansfield, where about 150 persons reside, a 30-kw transformer is sufficient; at Stonington three 25-kw transformers meet the requirements, and at Mystic three 75-kw transformers handle the business. All of these transformers step the potential down from that of the incoming lines to 2300 volts for local service. There are also at Stonington an 8.8-kw tub transformer for street lighting and a 17.5-kw tub transformer at Mystic for the same service. All of the line work of the system is handled from Westerly, five employees taking care of it. In general, the company strives to do away with small and relatively inefficient transformers, replacing them by fewer larger units and concentrating the loads in groups. The power house requires a staff of six men. One man handles the work at Mystic and two employees take care of the office work at Westerly. Each transformer substation is inspected every other day. The street lamps in the outlying towns are turned on and off by persons of responsibility who are not regular employees of the company, but who are hired to handle this work daily.

The following table gives the operating results at the power station in Westerly of a 640-kw Diesel engine plant for the eight months ending Aug. 31, 1909:

OPERATING COSTS.

Total kw-hours generated	1,233,590
Energy required for operation of compressors, circulating pumps and exciters kw-hours	312,380
Total kw-hours available for distribution	920,710
Gallons fuel oil used	115,708
Gallons fuel oil per available kw-hour	0.12
Cost of fuel oil, including lubricating oil and water	$3,632.22
Cost of fuel oil (as above) per kw-hour available	0.0039
Cost of generating energy, total	8,750.67
Cost of generation per available kw-hour	0.009
Cost of distribution	6,335.73
General expenses	6,462.31
Total cost of energy	$21,548.71

DETAILED COST OF ENERGY.

Generating.	
Operating:	
Fuel oil	$3,356.10
Lubricating oil	236.75
Water	39.37
Labor	3,685.43
Miscellaneous	68.52
Total	$7,386.22
Maintenance:	
Engines and compressors	$905.34*
Electrical equipment	58.96
Miscellaneous	25.15
Total	$985.45
Superintendence	375.00
Total generating	8,750.67

*Includes general yearly overhauling.

DETAILED COST OF DISTRIBUTION.

Operating:	
Street labor	$541.35
Street miscellaneous	405.95
Commercial labor	1,231.86
Commercial miscellaneous	1,337.22
Total	$3,516.38
Maintenance:	
Poles and lines	$2,339.73
Meters and transformers	104.62
Miscellaneous	0.00
Total	$2,444.35
Superintendence	375.00
Total distributing cost	6,335.73
Total cost of energy, generating and distributing	15,086.40
Total cost of energy, including general expense	21,548.71

The company had 1242 customers on Aug. 31, 1909, and of these 70 were motor users, having a connected load of 458 hp. The rates for motors are, in general, from 5 cents to 1.75 cents per hp-hour, with a minimum monthly charge varying from $2 for a 0.25-hp motor to $25 for a $25-hp connected load. The net rate in the stone yards averages from 2 cents to 3 cents per hp-hour. About 250 hp of the company's connected load is located in Westerly, and in Noank a load of 110 hp connected is in service at a shipyard. The motor service usually is provided on the basis of a shutdown of the motors in the stone sheds at about 4 p. m. daily, so that the lighting and the motor peaks do not overlap. The motors in the stone sheds are used mainly for operating air compressors, and the prospects for increased service in this line are attractive. The long steam lines formerly required for this work were expensive to operate and maintain. In the shipyard service the company operates tools in the carpenter and blacksmith shops, and enables the shipbuilding company to work without burning up valuable timber as fuel. In Westerly 26 gasoline engines have been displaced by electric motors, largely on the grounds of superior economy and greater reliability of service. This has been done in the face of the fact that there are two active agencies in the town for the sale of gasoline engines. In several cases motors are used to hoist boats out of the water, the work formerly having been done by gasoline engines. In one representative case a 20-hp gasoline engine in a wheelwright's establishment was replaced by two motors rated, respectively, at 1 hp and 7.5 hp. Four men were formerly required to start the engine in this installation. In the stone yards the speed with which the motors can be started has been found to be valuable, compared with the delays incidental with steam machinery fed through long, crooked and often cold pipes.

The lighting rates run from 16 cents per kw-hour downward, according to consumption, with a minimum charge of $1 per month. Short-time customers at the shore are charged at the initial rate of 25 cents per kw-hour, with a minimum bill of $2 per month, and a 20 per cent discount up to a bill of $12.50. An additional 5 per cent discount applies for prompt payment, and the all-the-year-around customers have discounts of from 5 per cent to 50 per cent according to their utilization of energy. About 300 electric flatirons are in service on the company's circuits. A special rate of 5 cents per kw-hour is made for tailor irons, and these are put on separate meters. A fair average revenue from each of these is $35 per year. Ten such irons are now in service. A rate of $1 per month is also made for meat choppers and coffee grinders, up to ½ hp. The largest motor in service at present is rated at 35 hp, in a stone yard, and the largest individual consumer's transformer is rated at 20 kw. The company supplies 40-watt to 100-watt tungsten lamps for commercial service and sells them at the list price. Free renewals of carbon lamps are made from 4 cp to 32 cp. In general, the maximum rating in a motor permitted on a lighting circuit is about 0.25 hp.

The officers of the company are: President, Mr. William Clark, Westerly; vice-president, Mr. W. L. Mauran, Providence; treasurer, Mr. Thomas E. Steere, Providence; general manager, Mr. H. B. Rust, Providence; local manager, Mr. M. H. Spellman, Westerly. The engineering of the entire plant and the installation of the station was done by H. B. Rust & Company, Providence.

Electric Cranes.

By Warren H. Miller,
Electrical Engineer, Standard Oil Company.

For the purpose of establishing a basis for the discussion of the various types of cranes, it seems well to present first a table giving a fair idea of the 20-ton hand-operated traveling cranes in the market as shown by proposals submitted in a recent competition for a contract, indicated in Table I. The hand-operated crane is well adapted for use in power houses and small machine shops. Moreover, this type of crane costs not over one-half as much as does an electric crane for the same service.

In a hand-operated crane the gear ratio of the overhaul of the bridge should be about 9 to 1, and that of the trolley 6 to 1. It is exceedingly important to have large wheels—not less than 24 in. in diameter—for the bridge; the larger the wheels the easier will be the traveling. When a heavy crane must be operated with a 40,000-lb. engine frame hanging to it, the least inequality of the track becomes a serious obstacle if the wheels are too small. The drum type of hoist is well worth its extra cost over the chain block type. It will not stick at critical

moments, nor let things down with a jar just when smooth, fine handling is desired, and in many ways it has much to commend it over the chain block. The width under the hook, as shown in the table, is of importance, as when multiplied by the length of travel, it gives the number of square feet served by the crane, which should be checked to see that all important machinery can be reached by the hook. Power-house transformers, which must be lifted vertically out of their

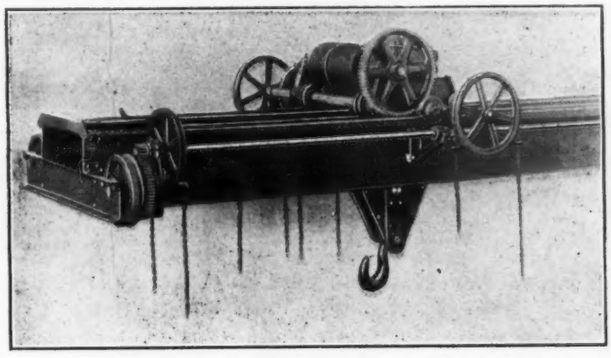


FIG. 1.—HAND-OPERATED 20-TON DRUM-HOIST CRANE.

shells, are the most frequent offenders in this respect, being generally placed against walls or in cubby holes or buried under a mass of wires.

In addition to the bare figures of the competition tables, there are many points in all classes of cranes which must be carefully compared. The rigidity of the bridge connections to the end trucks, and the size and arrangement of gears to operate the travel of the bridge, must be carefully studied to see that the crane will have no tendency to twist or run with one side ahead of the other, thus binding the wheels on the runway. The casting of the gears and wheels in one piece is a bad feature, for the loss of a single tooth will mean discarding the whole wheel. The axles, bearings and attachment of the bearings to the truck should be examined to see that it is rigid, will not shake or rattle apart, and will permit rolling the wheel out by some such simple operation as driving a wedge in between the truck and the rail, thus taking the weight off the wheel. The bearings should be so designed as to permit sliding them out horizontally, or else the pin itself should be capable of easy removal for freeing the wheel. Much attention should be given to the strength, ease of removal of wheel and of removal and repair of gears. The

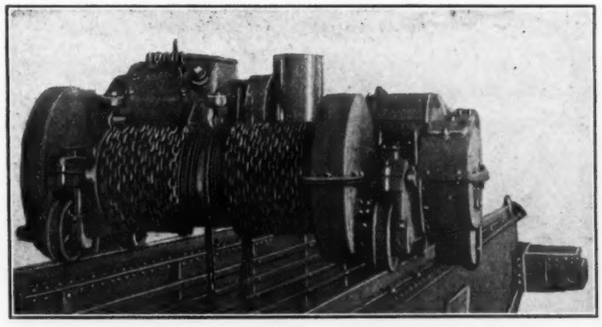


FIG. 2.—DRUM AND GEAR BOXES, ALTERNATING-CURRENT CRANE.

frame should be of either cast steel or structural steel—too many disastrous accidents are already on record from the snapping of cast-iron trolley frames. The gears, if "dust-proof," should be really dust-proof, or else they will prove to be simply dust reservoirs, and the parting lines of the gear casings should be so placed that the oil cannot drip down into the shop below. All of the motors should be checked for strength. A good set of rule-of-thumb formulas for this purpose is here given:

$$\text{Horse-power of hoist motor} = \frac{\text{speed in feet per minute} \times \text{load (tons)}}{11}$$

$$\text{Horse-power of bridge motor, or of trolley motor} = \frac{1/10 \text{ total weight (tons)} \times \text{diameter axle} \times \text{speed}}{\text{Diameter trolley wheel} \times 13.2}$$

The rating of the generator needed to operate the crane = ⅔ total horse-power of the motors on the crane.

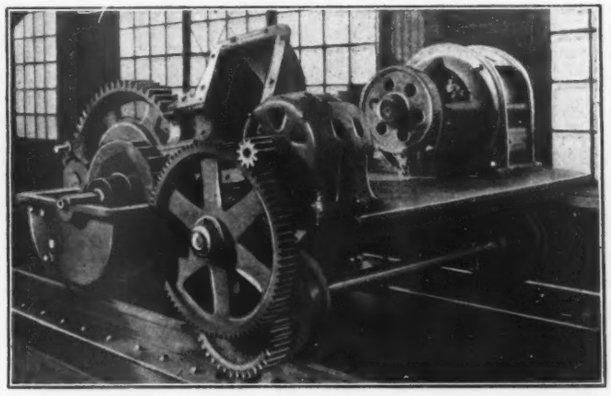


FIG. 3.—ERECTING SHOP ALTERNATING-CURRENT CRANE.

The next features to be considered are the magnetic and mechanical brakes. The alternating-current and the direct-current magnetic brakes are equally simple and reliable, the former consisting of a solenoid with a core which it tends to draw into the central position with respect to the coil. When three-phase current is used the magnet is connected as a single-phase device; as the total current is only a few amperes, its unbalancing effect is entirely negligible. In the mechanical-hoist brake the idea is to insure the maximum of safety, and to that end the brake in some cranes is set to hold the load up at all positions and the hoist motor simply forces the load up or down over the resistance of the brake. A more durable

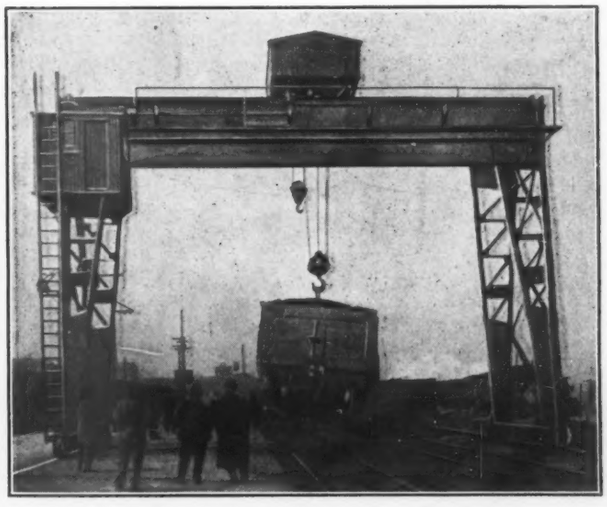


FIG. 4.—ALTERNATING-CURRENT GANTRY CRANE.

brake is one in which the wood and steel disks are released at the will of the craneman, but they are normally set.

The function of the magnetic brake is principally to prevent automatically any overtravel of the motor armature or rotor. Its solenoid core is attached to horns which surround a flanged wheel on the stub end of the motor shaft, and releases this wheel when there is current in the circuit. At any other time the motor is locked and cannot turn. In fact, the whole idea of movement control in a well-designed crane is that of

having everything tied up and secure except when released for operation.

Another feature which should be subjected to scrutiny is the provision made by the designer to give access to the motors, gears, and moving parts. The platform reaching the bridge motor should extend completely across so as to allow prompt and easy access to the gears and trucks of the crane at the end opposite the cage, and, of course, the cage itself should be hung at one side of the crane so as not to interfere with the hook when hoisting is being done at the cage end of the crane. As regards the crane girders, for loads exceeding 15 tons, there are available both box and plate girders, full depth and fish belly, and also truss girders. It is a realm of structural engineering where one can choose nearly as fancy dictates, since all have points of excellence, except that there is little excuse for the full-depth girder, as it is unnecessarily unwieldy. The truss type gives a light, rigid crane. With any great depth or length, the plate I-beam type cranes show a very noticeable flabbiness, and the men cannot be induced to accelerate them to full speed because of nervousness as to the safety of the trolley engendered by the quivering and wabbling of the long flat plates. For maximum rigidity, lightness and strength, and good, firm connections to the end trucks, the fish-belly box girder type is excellent.

TABLE I.—HAND-OPERATED CRANES, 20-TON, 63-FT. SPAN.

Maker	Hoist		Bridge Ratio of Overhaul	Price, Dollars	Delivery, Days	Clearance		Type of Hoist	Extra Charge for Erection, Dollars	Type of Plate Girder	Weight, Lbs.	Clearance Under Hook, Feet
	Height, Ft.	Speeds				Side, Ins.	Head, Ins.					
A1	15.25	2	...	1,590	14	7.00	51.25	Block	200	Fish belly	32,800	57.7
A2	17.25	2	...	1,520	14	7.00	57.75	Drum	200	Fish belly	32,800	58.0
B	17.25	3	7:1	1,985	30	7.25	46.25	Drum	...	Fish belly	28,000	57.8
C	19.00	2	9:1	1,815	30	7.00	64.00	Block	...	Girder	.....	59.2
D	15.25	..	...	2,103	21	7.50	53.00	Block	200	Fish belly	.....	59.2
E	19.00	2	...	2,195	30	6.62	61.50	Drum	225	Girder	33,800	57.7

The contract was given to A2.

TABLE II.—THREE-PHASE CRANE MOTORS FOR 220 OR 440 VOLTS.

25 Cycle Crane Motors				60-Cycle Crane Motors			
H.P.	R.P.M.	Weight lb.	Price	H.P.	R.P.M.	Weight, lb.	Price
4.5	650	745	$236	3.0	950	470	$111
7.5	670	1,010	264	4.0	950	550	132
15	680	1,570	345	7.5	1,450	580	153
22	690	1,720	390	11	820	1,060	287
27	460	2,510	501	15	820	1,110	294
37	680	2,250	492	18	650	1,410	362
....	....	....	....	22	1,100	1,150	303
....	....	....	....	22	650	1,600	394
....	....	....	....	37	550	2,350	540

rating of the crane, the tendency of the series motor to run at high speed under light load results in a great saving of time. This is the only real advantage of the direct-current over the alternating-current crane, and it may be completely offset by the fact that since the bulk of shop loads are light the speed of the hoist can be designed accordingly, dependence being placed upon the big overload range of the alternating-current hoist motor for the heavier loads. The writer has installed and used alternating-current cranes ranging in rating from 120 tons down to 5 tons for all services including such delicate work as setting flask copes in a foundry, and the weight of experience with both types, extending over a number of years, is entirely in favor of the alternating-current crane. It is not strange that the reverse opinion should be almost universal. Most of the crane companies build their own direct-current motors and, naturally, their effort toward the engineering public, ignorant of this specialty, is to suggest the use of direct-current cranes as much as possible for the sake of the motor and repair sales. One is told that the alternating-current cranes are slow in starting, have little or no overload range, fail to hoist whenever something a little above normal is needed in emergency, are clumsy and inaccurate in handling the hoist, and represent only about 4 per cent of the crane business. Even the magnetic brake is harped upon, and the purchasing engineer is scared into believing that it has special and dreadful troubles of its own.

Here are facts taken from practical experience: A 20-ton, alternating-current crane, constantly handling large castings in a machine shop, has lifted pieces weighing up to 28 tons

TABLE III.—THREE-PHASE, 25-CYCLE CRANES, 15-TON, 47-FT. SPAN.

	Hoist		Trolley		Bridge		Price, Dollars	Delivery, Days	Clearance			Weight, Lbs.	Gear Covering
	H.P.	Feet	H.P.	Feet	H.P.	Feet			Side, Ins.	Head, Ins.	Rail to Top, Ins.		
A	27	16	7.5	100	20	250	4,720	40	8.5	48	78	45,000	Enclosed
B	22	14	4.5	125	15	250	6,150	90	10.5	42	84	45,500	.....
C	22	14	3.0	100	18	250	4,690	90	8.0	40	70	34,900	Enclosed
D	27	18	6.0	100	22	250	4,600	45	8.0	...	82	42,000	Enclosed
E	22	18	3.0	125	20	320	4,692	104	6.6	...	74	38,000	Open
F	27	16	4.5	100	22	275	4,700	45	8.5	...	81	48,000	Open
G	37	23	4.0	100	18	250	2,600	60	9.0	...	81	34,000	Open
H	25	16	5.0	100	25	250	4,595	90	7.5	58	84	.....	Open

The contract was given to D.

Direct-current cranes are so well known that only a few comments are needed here. Five years ago they were more or less of a nuisance, as the gears were poorly protected and the motors less so. At least once a day compressed air had to be used in cleaning the motors and gears, particularly in foundry and forge-shop service, and all motor commutators, brushes, controller fingers, etc., had to be inspected and cleaned, oiled or adjusted. The direct-current cranes of the present day are far neater and more dust-proof than the earlier designs, but the commutator and controller troubles have not been eliminated, and they bid fair to remain because of the persistency of the direct-current arc.

The principal advantage of the direct-current series motor is that it will increase its speed at light loads, and the heavier the load the slower the lifting and the stronger the pulling. As the vast bulk of shop loads are much lighter than the full

as part of its daily work during the last five years. A 15-ton, alternating-current crane handles all classes of fine-plate fittings in a boiler shop, and as part of its regular work carries the curved plates out of the bending rolls—an operation requiring the most exact handling, because both the crane hoist and the bending roll motor must work at precisely the same speed of the plate will be defective. A 5-ton and a 30-ton alternating-current crane, working together in a foundry, per-

form all the delicate work, such as hoisting and setting large copes, etc. All of these cranes start and stop with the same promptness as do direct-current cranes. Repairs were never more serious than a few controller fingers in two or three years. No one has been near the motors of the crane in the boiler shop during the last seven months, except once to fill the oil reservoirs of the journals. In the case of this same crane, some trouble was at first experienced with the speed, which was set at 18 ft. per minute for 15 tons. Since an induction motor cannot go faster than synchronism, 18 ft. per minute was the limit of hoist speed, no matter how light might be the plate. This speed was entirely too low, and hence the gearing was at once changed to give a speed of 40 ft. per second. With this speed all of the regular shop work is conducted smoothly, and for a large part of the time 10-ton or 12-ton loads are being lifted with no abnormal heating of the motor. What actually happens is that the speed of the motor decreases under such loads and the motor carries about 40 per cent overload for the short time while load is being lifted. When it is recalled that all induction motors are sold with a 25 per cent continuous overload guarantee at 50 deg. C. rise, it will be appreciated that the extra 15 per cent is no especial hardship, whereas with the direct-current motor the limit of its practical load is soon reached because of the excessive sparking of the brushes. The temperature of the induction motor may increase slightly, as will also that of the direct-current motor, but it is not necessary to sandpaper any commutator, and no one worries about the extra heat in the least. The above-mentioned crane has been in operation for two years and gives entire satisfaction with the 40-ft. speed of hoist, the overload range of the motor being utilized for lifting heavy loads.

Concerning the magnetic brake, a moment's consideration of the fact that a solenoid works equally with alternating current as with direct current will convince one that no particular trouble may be expected from that source, nor has any been yet reported among the cranes under the writer's jurisdiction.

Table II will serve to give an idea of prices and other data relating to three-phase cranes.

All alternating-current crane motors are induction machines with provision for inserting resistance in the secondary circuit. The controllers are of the usual street-car drum type and the rheostats are hung in the crane cage. As the alternating-current arc is not nearly so persistent as is the direct-current arc the depreciation of controller fingers is much less than with direct-current controllers. Table II gives a list of alternating-current crane motors designed for 60-cycle and 25-cycle, with approximate prices. Table IV is laid out with a set of suitable crane rails, runway girders and wheel loads for various sizes of cranes, either alternating current or direct current.

TABLE IV.—CRANE INSTALLATION DATA.

Tons	Span, Feet	Rail, Lbs. per Yard	Rail, Height, Inches	Truck Wheel Span, Feet	Clearance Side, Inches	Wheels		Runway Girder			
						Number	Load on Each, Lbs.	Web, Inches	Flange, Inches	Top, Inches	Bottom, Inches
10	72	40	3.5	15	8	2	22,600	80-lb. I-beam	80-lb. I-beam	80-lb. I-beam	80-lb. I-beam
15	47	50	4.9	15	9	2	22,000	30 x 0.50	5 x 3.0 x 0.375	12 x 20 lb.	.....
20	65	60	4.25	22	10	2	39,900	30 x 0.50	5 x 3.5 x 0.5	12 x 0.375	12 x0.375
30	70	60	4.25	22	12	2	55,000	33 x 0.50	5 x 3.5 x 0.5	12 x 0.375	.....
100	72	100	5.75	22	18	4	71,000	45 x 0.75	5 x 5.0 x 0.75	15–50 lb.	12x1

In conclusion, it may be stated that where direct current is immediately available there is no especial disadvantage in using direct-current cranes, but where alternating-current is used it is unnecessary to install special converting machinery or extra circuits from the exciter generators for supplying energy to direct-current cranes, because alternating-current cranes give even better service.

Electrical Engineering at the University of Birmingham.

By J. H. Aswell.

During the present year there has been inaugurated in England a university which provides an education of a more commercial character than that provided by the older universities of Oxford and Cambridge. Commerce and engineering are the outstanding items in the curriculum of Birmingham University. Of the applied science side, electrical engineering is certainly catered for to a very large extent.

FIG. I.—GENERAL VIEW OF BIRMINGHAM UNIVERSITY BUILDINGS.

The full courses extend over four years, and should the student have matriculated before entering, he is, on the completion of that time, eligible for the degree of Bachelor of Science

in Engineering, provided the necessary examinations and practical work have been successfully completed. In his first year the student attends special classes in mathematics, physics and chemistry in addition to engineering lectures, drawing and workshop. Chemistry is dropped in the second year, and further lectures in mathematics, physics and engineering are taken. In his third year he devotes his whole time to engineering and mathematics, accounting taking the place of the latter in the fourth year.

The university has been fortunate in securing the services of men well known in engineering circles. Professor Kapp and Dr. Coales are at the head of the electrical section, and, needless to say, the students benefit to a very large extent by the world-wide experience of the former.

Turning now to the actual equipment. In the power house, which supplies energy for lamps and motors required by the whole of the extensive buildings, are machines of widely divergent types, which are tested by the students under working conditions. They are coupled to high-speed and low-speed steam engines and gas engines and to turbines. There are high-voltage and low-voltage machines, of both the direct-current and alternating-current types. Alternating current is supplied to a Siemens machine in the storage-battery house, which drives two 240-volt generators for charging the respective halves of a 440-volt battery of E. P. S. cells which is used for lighting several of the buildings and the women's hotel. Ample means are provided for giving any of the machines artificial loads, inductive or non-inductive. In the power station is Professor Burstall's "Premier" gas engine on which he has obtained the record thermal efficiency of 42 per cent.

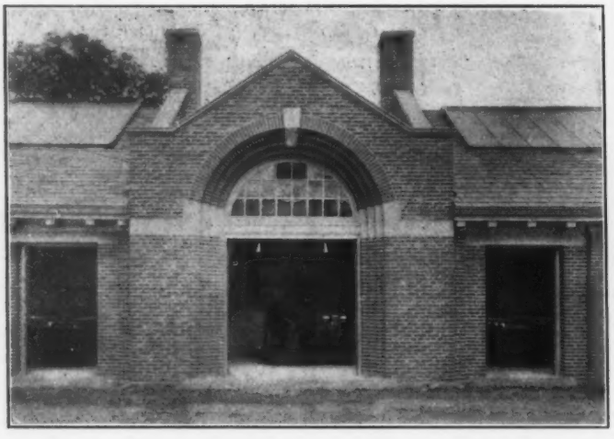


FIG. 2.—BATTERY HOUSE.

FIG. 3.—SENIOR ELECTRICAL LABORATORY.

The main electrical laboratories occupy a block of the main buildings about 900 ft. away, and cover an area of 10,000 sq. ft. On the lower ground floor is the senior laboratory; in one corner is a small workshop for making new apparatus that may be required for the department or for carrying out repairs to that already in use. One side of this floor is reserved for cable and transformer testing, while the other is fitted with testing beds and fixed machines, as shown in Fig. 3.

At the present time there are on the test beds many types of generators and motors; among the chief are: a Déri single-phase commutator motor; a Winter-Eichberg single-phase motor controlled by movable brushes; a small Westinghouse rotary converter; a 10-hp Holmes-Lundell motor; a meter-testing set comprising three machines—the generator has a swiveling stator so that any phase difference can be obtained. There are also tramway, crane and induction motors of various types, and a Rosenberg train-lighting generator in addition to other small motors and generators.

Before detailing the fixed machines it will be necessary to enumerate the different currents and voltages which may be obtained within the laboratory, namely: direct current up to 250 amp at 110 volts or 220 volts, and from 300 amp to 600 amp at from 2 volts to 12 volts; three-phase, 50-cycle and 30-cycle current at 200 volts up to 40 kw.

A battery-room is situated below the large switchboard at the south end of the laboratory. The main battery consists of 112 cells of the E. P. S. central-station type, having a normal discharge rate of 40 kw at 220 volts. There is also a battery of six cells for obtaining low pressure of from 2 volts to 12 volts. The leads from these latter are connected to a plugboard close to the main board and distribution to the isolated laboratory circuits is effected from that point.

The main switchboard of seven panels is used for controlling the battery charging and the various supply leads. It was designed by Messrs. Siemens Brothers, of Stafford, and is equipped with many styles of instruments so that students may compare them under actual working conditions. All the currents stated above may be obtained even while the battery is being charged. The various pressures are regulated by the apparatus and machines in the laboratory, so that no one portion of the battery will become discharged more than another. This arrangement avoids any deterioration due to constant overcharging, which would accrue if the current was drawn from different points.

The battery is charged from the direct-current 110-volt supply system by a British Thomson-Houston 28-kw set. If it is necessary to charge from the alternating-current side a 30-kw rotary converter, made by Brown, Boveri & Company, is available. Hence the charging of the battery is not so dependent on the power station as would be the case if energy was procurable from only one source.

The fixed machines are run to deal with the various supplies as follows:

The 220-volt direct-current supply is obtained from a battery, pressure variations being taken up by a Thury automatic reversible booster, built by the Compagnie de l'Industrie Electrique, of Geneva. A 30-kw motor-generator set enables energy at 220 volts to be obtained while charging, the critical pressure being regulated by the Thury booster. For the 110-volt supply the rotary converter is run from the direct-current side and current is taken from the middle point of the auto-transformer as a neutral point and from one main lead. The low-voltage direct-current supply is obtained from the battery, but where special regulation is required the main booster can be utilized in addition to the large cells mentioned above.

For 50-cycle alternating current a direct-current motor run from the 220-volt system drives a 25-kw alternator. This set was built by the Brush Electrical Company, of Loughborough. The 30-cycle supply is obtained by running the converter from the direct-current side.

In addition to the connections to the main board, each set has its own special switchboard; Fig. 4 represents the panel of such a board, which is provided for the alternator of the Holmes set. This alternator can be star-connected or delta-

connected, giving either 70 amp or 103 amp at from 30 cycles to 50 cycles. It is driven by a "Castle" type 220-volt motor. The terminals on the lower portion of the right-hand panel enable the alternator to be coupled up to any of the three-phase loads or ring mains. These auxiliary panels enable any experimental work to be carried on without interfering with the routine work

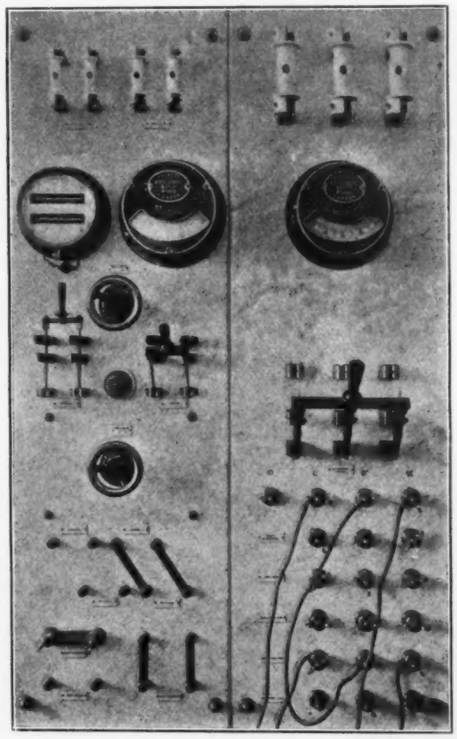


FIG. 4.—A MACHINE SWITCH PANEL.

of the department. On each panel are terminals which permit any pressures or currents to be transmitted to a standardizing-room which contains accurate standard instruments, oscillographs and other special apparatus. All of the switchboards within the building are protected at the rear by expanded-metal guards, so that they may be examined by the students without danger.

On the upper ground floor are the professors' rooms, stores,

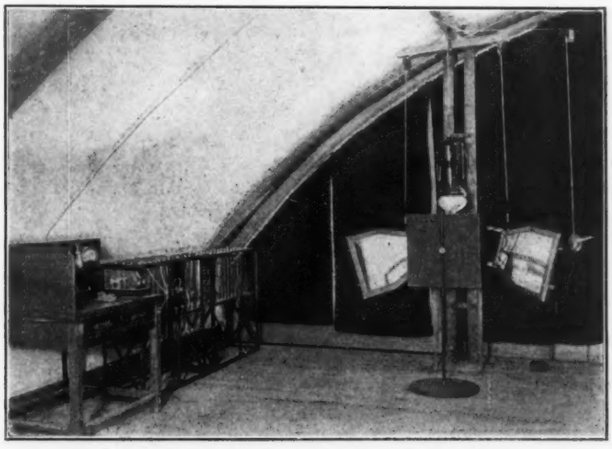


FIG. 5.—ARC LAMP PHOTOMETER.

departmental library, research and junior laboratories. Rooms are equipped for photometric and ballistic work. Many of the fittings are decidedly novel and speak volumes for the efficient organization of the department. In all of the laboratories are boxed switches and terminals so that energy can be obtained in any form desired. The lecture-rooms, the largest accommodating 400 students, are similarly equipped with switchboards so that any desired current can be obtained for demonstration purposes.

On an upper gallery is the arc-lamp photometer, shown in Fig. 5. The arc is shielded from the photometer by an opaque screen, the light being reflected from mirrors which may be adjusted to any angle. The bench to be seen on the left of the illustration is used by the operator controlling the arc being tested. A Lummer-Brodhun photometer is 10 m distant, a carbon-filament lamp being used as standard. A museum contains samples of materials for the construction of electrical apparatus, besides many spare parts of small machines. These have been presented or loaned by firms anxious to show their appreciation of the work undertaken by the university; an especially interesting exhibit is the first Edison "Z"-type dynamo, made in New York in 1881.

The chemistry department is well equipped for conducting research in electrochemistry and metallurgy. The equipment, which is almost identical with that of the physics department, consists of a 240-amp-hour battery of Tudor cells; a motor-generator giving 100 amps at 65 volts; a motor-alternator set running at 750 r.p.m., giving 35 kw, single-phase. The

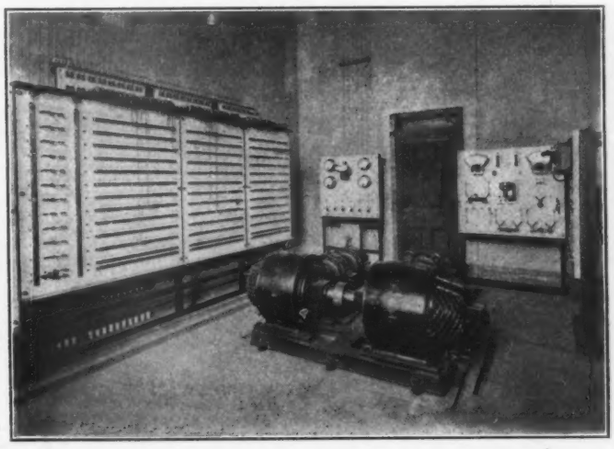


FIG. 6.—MACHINE-ROOM AND PLUGBOARD IN PHYSICS DEPARTMENT.

armature of the latter is made in four sections, each giving 350 amp at 25 volts, which can be put in series or parallel. The field current is obtained from the battery.

The main plugboard, illustrated in Fig. 6, is in the dynamo-room; it distributes energy to the subsidiary boards in the laboratories. Heavy bars extend to the electrochemical laboratory, for a Moissan furnace, capable of carrying 1500 amp. The equipment of these two latter sections—physics and chemistry—has been entirely in the hands of Messrs. Steinthal & Boydell.

Mention must be made of the University of Birmingham Engineering Society, which is responsible for that most creditable production, the *Birmingham University Engineering and Mining Journal*, and for the holding of various meetings and visits, so that the students may discuss questions and obtain knowledge of such a kind that is not usually imparted in the regular lecture courses.

Alternator Giving a Sinusoidal E. M. F. Wave.

In a patent issued on Oct. 5, 1909, to Dr. C. P. Steinmetz, upon an application filed Aug. 13, 1908, there is described a method of so arranging the armature winding of an alternator that the e.m.f. wave will be substantially free from all of the harmonics below the thirteenth. Use is made of a three-phase star-connected winding, which produces no third or ninth harmonic in the e.m.f. wave. There are nine slots per pole and each coil spans seven slots, or has a 7/9 pole-pitch. Since this value is approximately 4/5, the fifth harmonic is

eliminated in each coil and hence does not appear in the phase e.m.f. The conductors of each phase winding are not grouped in the usual manner with three coils at each pole, but the groups at the several poles differ in the number of coils per group, so that half of the coils of the phase winding are displaced from the other half by 1/9 of the pole-pitch. This value is sufficiently near 1/7 to eliminate substantially from the e.m.f. wave both the seventh and the eleventh harmonics.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Tungsten Lamp Prices in Chicago.

Tungsten lamps are now supplied by the Commonwealth Edison Company, Chicago, at reduced prices in renewal for standard carbon lamps. When carbon lamps are returned by the customers tungsten lamps are given in exchange at the following prices:

25-watt	clear		$0.45	
40	"	"	0.50	(small size)
40	"	"	0.55	(large size)
60	"	"	0.60	
100	"	"	0.80	
150	"	"	1.10	
250	"	"	1.60	
40	"	Meridian	0.65	
60	"	"	0.85	

The company makes an additional charge of 5 cents a lamp for frosting.

Central-Station Exhibit at Local Fire Company's Indoor Fair.

The Columbia Electric Light, Heat & Power Company, of Columbia, Pa., recently took advantage of an excellent opportunity for inexpensive but valuable advertising, when, in connection with an indoor fair held by a local fire company, it conducted a most attractive exhibit and demonstration of electric household appliances. The illustration shows the excellent arrangement of the booth, which always held the attention of many interested onlookers.

The fair was held from Oct. 14 to 25, and in view of the worthy cause, attracted large crowds, among whom were the city's best and most substantial householders. The display, which was an expense of less than $50, was pronouncedly the "hit" of the fair, and the company has been the recipient of many expressions of congratulation from both public and press.

CENTRAL-STATION EXHIBIT AT COLUMBIA, PA.

Electric Energy Used in Government Work at Buffalo.

The United States Government is spending $1,000,000 in deepening the channel from the foot of Main Street to Black Rock, Buffalo, and in building a ship lock. The lock will be 817 ft. long, 70 ft. wide in the clear, the walls are to be 26 ft. at the base, 8 ft. at top and 53 ft. high. In pumping the water electric motors were used, energy being supplied by the Cataract Power & Conduit Company from the Ontario Street terminal house. The pumping equipment was as follows: Two 12-in. Buffalo Pump Company's centrifugal pumps, one belted to a 200-hp Westinghouse three-phase, 25-cycle induction motor, and the other to a 100-hp motor of same make and type, and a 15-in. pump driven by a 200-hp motor. These were installed at one end of the cofferdam, while another is now being installed near the other end to pump out the water which comes from springs and leaks. The motor is rated at 200 hp. The lift is 45 ft. and the rating of the pumps are as follows: 12-in., 4200 gal. per minute and 15-in. pump, 7000 gal. per minute. A temporary transformer station was erected, the transformers stepping the e.m.f. from 11,000 volts to 2200, which was used at the motor.

Central-Station Float in Industrial Parade.

During the recent industrial exposition held in Rochester, N. Y., the Rochester Railway & Light Company in addition to supplying the energy gratis used in the illumination, had a float in the industrial parade forming part of the exhibit. The float, which is shown herewith, was built on a two-ton electric truck, the battery of which furnished energy also for a motor-driven triplex pump, shown on the rear of the wagon. The pump was employed to circulate water over a cascade, the water being collected in a tank at the bottom of the vehicle and returned to

FIG. I.—FLOAT ON ELECTRIC TRUCK.

the top again. Along the line of march three barrels of water were kept in readiness as a make-up for whatever water was spilled from the wagon en route. On either side of the front of the wagon was a model holding a wand tipped with a 60-

FIG. 2.—VIEW OF ELECTRIC PUMPS ON FLOAT.

watt tungsten lamp. Suitable signs were displayed on the sides of the float so that they who ran might read, and the cascade was appropriately set off with branches and rustic foliage.

Discussion on Consumers' Deposits at the Illinois Convention.

At the Illinois Electric Association convention in October there was some discussion of the question of requiring a cash deposit from new consumers of electric lighting companies in order to secure the company against bad debts. Mr. David Davis, of Litchfield, said that at Litchfield he had adopted the plan of the Laclede Gas Company, of St. Louis, of requiring either a deposit from a new consumer or the signature of the owner of the property on the application. He argued that since the owner of the property, or landlord, is usually much better posted as to the credit of a prospective tenant than is the manager of a lighting company, it is logical to require his endorsement of the application. In fact, in the case of one water company the water bills are made out against the property owners only and are included in the rent. He thought that gas and electric service might come to be considered the same way. Mr. E. W. Smith said that the plan of requiring a deposit is used at Kewanee. Mr. N. M. Argabrite, of Belvidere, accepts the signature of any property holder in the town, because sometimes a tenant does not like to go to a new landlord for such signature, and he might be scared away from the company's service. Mr. F. H. Golding, of Rockford, said that it costs his company 0.4 per cent to collect its bills, and that the losses are not over 0.25 per cent. Mr. Frank J. Baker, of the North Shore Electric Company, Chicago, said that the Wisconsin commission had upheld the policy of requiring a deposit of new consumers. The consumers submit more gracefully to making such a deposit if that fact is known. However, Mr. Baker did not favor the deposit scheme for general application, and his company requires deposits only in extreme cases, where the credit is known to be bad. It creates a bad impression on a consumer to be met with a demand for a deposit as soon as he starts to do business with the company. It is one of the things which make people wish for a competing company in a town. The company should not err on the side of being narrow. In the electric lighting business, where people do not have to use electric light, they do not seem to object so much to the deposit as in the water business, where the consumers feel that they are entirely in the power of the company, because water is a necessity.

Mr. H. J. Pepper, of Champaign, said that he did not think much of the deposit scheme when the parties are known. Mr. E. L. Brown inquired: "Why require a deposit from a new consumer when other lines of business do not?" A man starting in business in a small town is given credit by everyone for a time. The electric lighting company takes smaller chances than many other tradesmen with a new customer, and it creates a bad impression if a deposit is required.

Mr. John F. Gilchrist, of Chicago, called attention to the fact that the People's Gas Light & Coke Company, of Chicago, with its thousands of consumers, requires no deposit from new consumers, unless they have been previously connected to the company's mains and failed to pay their bills. The Commonwealth Edison Company, with its thousands of consumers, does the same thing. He did not favor starting relations with new consumers by treating them as suspicious characters. In cases where the new consumer's credit is known to be bad, a deposit is required, but if his bills are paid promptly for a period of 18 months this deposit is returned with 5 per cent interest.

Electric Power at the Illinois Convention.

Mr. F. H. Golding, manager of the Rockford Electric Company, presented a paper entitled "Power" at the Illinois State Electric Association convention at Alton, in October, of which an abstract follows:

Mr. Golding said that a decade ago the value of a power consumer, and consequently his rate, was based entirely on kw-hour consumption, but since people have come to realize that to give an improved station load factor, thus also bettering the net returns to security holders, more careful consideration must be given to the other vital elements governing the desirability of power business. The most important of these greater considerations are hours of usage, load factor and capacity demand.

Hours of usage can probably be taken as the most important factor in making a power rate, and the consumer whose business can be regulated to suit an "off peak" schedule as well as the 24-hour consumer with a fair load factor, such as a paper mill, refrigerating plant or knitting mill, must be considered as much more desirable than the 10-hour consumer whose power overlaps the lighting peak, and should in consequence be entitled to a much lower rate.

The load factor is a very essential feature of power business and should receive careful attention. The burden imposed on the central station by an installation with a low load factor should be, at least in part, borne by the consumer in the form of a proper adjustment of rate.

In determining a rate the capacity demand is a question which requires judicious handling, as if a general rule basing it on horse-power connected is followed, a hardship is imposed on the consumer with individual motor drive and on the one who purchases larger motors than are necessary at the time, with a view of providing for the future expansion of his business. Undoubtedly the most satisfactory method of arriving at the capacity demand element is by the installation of recording maximum demand indicators, the demand being based upon the average of a predetermined number of peaks, of three or five minutes duration each, occurring in any one month. In cases where the cost and maintenance of maximum demand indicators would not be justified, fairly good results may be obtained by basing the capacity demand upon the connected transformer capacity when alternating current is used and upon control of

fuse sizes or with a circuit-breaker when direct current is used.

The most equitable power rate is one which embodies a suitable readiness-to-serve charge per kilowatt of maximum demand plus the current consumed at a meter rate, the flat charge to cover a proper proportion of general expense, distribution expense and investment charges and the meter rate to be based on station costs plus a suitable profit. In cases wherein the central station can control motor sizes and thus assure a reasonably high load factor, a demand rate with readiness-to-serve charge based on horse-power connected is applicable, but such a rate cannot in fairness be used to cover all installations.

In planning a systematic power campaign it is well to obtain complete and accurate data on each plant which may be considered a prospect. This data should embrace operating costs in detail, size, make, age and condition of the various classes of equipment, original cost of equipment, general condition of power plant and any other pertinent or unusual facts which might have a bearing on the subject. If possible the engine, or engines, should be indicated and a record of the average and maximum loads thus obtained. It is seldom wise to accept the prospective consumer's estimate of his requirements in lieu of the engine indication, as the average manufacturer will invariably overestimate the horse-power used in his plant.

Information of this character is not usually difficult to obtain, because as a general rule a factory manager either has so little knowledge of his costs that he is glad to have an expert work them out for him, or else he thinks he is making power cheaper than the central station can sell it and will give the desired data for the purpose of demonstrating to the power man that he (the factory manager) knows the business better than the central station does.

With an accurate report of this nature before him it is comparatively easy for the central-station man, before opening negotiations with the prospect, to determine whether a proposition can be made which will interest him and can also avoid the humiliation of submitting a power proposal to a manufacturer only to be shown that he is already making his own power cheaper.

Soliciting power does not bring as quick returns as the same effort on light solicitation, because as a rule a considerable investment on the part of the prospective consumer is involved and the average manufacturer must be convinced that the expenditure of a large amount of money is justified. One company which kept a man on power exclusively for two years is now trying the experiment of training lighting solicitors in power work and eliminating the special power man, with excellent results thus far, the theory being that, whereas the power man's frequent rebuffs tend to cause him to lose heart, the mixing up of light solicitation with power enables the representative to secure some business and so keeps him from becoming discouraged.

In the effort to secure the larger plants, it should not be lost sight of that it only takes a few little fellows to equal a big one, and that the former is usually much more profitable than a single consumer. One Illinois company recently decreased its direct-current district and in the course of reconstruction replaced about 350 hp in direct-current motors with alternating-current units. This company's restricted direct-current district was generally supposed to be "saturated," but within three months every one of the motors involved in the 350-hp exchange had gone back on the company's lines and the largest single installation was not over 15 hp. The average revenue from this lot of motors is easily 7 cents per kw-hour, whereas the company would undoubtedly be glad to get a single installation of the same size and load factor as this aggregate, at little more than a third of 7 cents.

DISCUSSION.

Mr. Golding was asked whether at Rockford it is the practice to collect a fixed charge from a consumer. He replied in many cases such a rate prevailed, the charge being $25 per horse-power connected per year, plus 3 cents per kw-hour for motors of less than 50 hp. A certain New York State company which buys from Niagara purchases and sells by what is called a firm horse-power, a term apparently peculiar to the locality of Niagara. This firm horse-power is determined by taking the average of three five-minute peaks during a month. In determining maximum demand at Rockford a curve drawing watt-meter is frequently used. Mr. Frank J. Baker, of Chicago, said that it is desirable to have some uniform method of determining peaks of consumer's loads. Connected load is not a correct basis.

Mr. H. C. Morrell, of Whitehall, told of a flour mill running constantly which has a steam plant costing its owner $100 per month to operate. He wanted to know whether he could safely agree to operate a motor at that figure. Mr. Baker suggested that the best plan would be to put a motor in on trial. This would demonstrate two things. It would tell the amount of power actually required and show the owner the convenience of the motor so that he would not be willing to give it up. Another member testified that motors put in on trial always stay. Mr. Linn, of Bloomington, said that motors put out on trial in his experience never come back.

Mr. J. G. Learned, of Chicago, suggested that a good move for a company just entering the power field is to try to secure the contract for pumping city water. Besides being a good kind of load to have it has a good moral effect on other power users, and helps to inspire confidence in electric power. When putting in motors on trial it is sometimes a good plan to give the consumer a year to pay for his motor. If a motor has only been in operation for several months the consumer's power plant gets so disorganized that he cannot start it up again.

Mr. N. M. Argabrite, of Belvidere, said he found that in building up an electric power load it was necessary for the company to take most of the chances, as the consumer will not take any.

Mr. H. R. Kingman, of Mt. Vernon, reported operating a 40-hp Wagner single-phase motor from a 75-kw generator. The motor is on its own feeder and runs 24 hours per day, pumping water. This was in answer to a question of a member as to the largest size of a single motor connected to a given generator capacity as operated by members.

INTERIOR WIRING AND ILLUMINATION

Electrical Wiring in Denver.

City Electrician J. F. Reardon, of Denver, Col., in a recent paper read before the business department of the Denver Gas & Electric Company, stated that during 1908 6000 permits were issued by his office and over 10,000 installations were inspected. The fees derived from these permits were about $10,500, making the electric inspection department self-sustaining.

The strict enforcement of the present wiring ordinance has been, he said, the means of establishing a better grade of wiring, and the wiring installed at the present time in Denver is on a par with that of the largest Eastern cities.

The city wiring ordinance gives the city electrician the power to decide all questions not provided in the ordinance and to make rules and regulations of a technical nature that may be deemed necessary to make the installation of electrical conductors and appliances as safe as possible. Under these sections several circular letters have been issued from time to time to electrical contractors interpreting the rules of the ordinance, thereby helping the electric wiremen in their work.

From time to time these letters have established a conduit system of installation in different classes of buildings with the result that at the present time all wiring in new buildings must be in iron-armored conduits. In old buildings concealed wiring must be installed in an iron-armored conduit where possible. Switch loops and wall outlets may be installed in flexible metal

conduits and open wiring in an approved metal molding.

The National Code, which is a part of the electric wiring ordinance, allows 1320 watts on a circuit for temporary work. To encourage the use of sign and display lighting the electrician has ruled that the same amount of watts may be used permanently on this class of work. All signs now used in Denver are made complete of metal with all wires concealed. This makes a first-class job of wiring and eliminates any fire hazard that might exist from wooden construction.

Special attention is paid to the inspection of theaters and moving-picture shows. Inspections are made weekly of the electrical apparatus of traveling companies to prevent, if possible, a repetition of the Chicago Iroquois fire. A licensed electrician is required to stand at the switchboard on the stage during all the performances, also a man at each arc lamp. These men are trained in their duties and feel the responsibility for them.

Lamp cord of any description is not allowed to be used on the stage except for low-voltage battery work. Exposed live contacts, such as switches, binding posts for wires and the like, are entirely eliminated. All such apparatus is enclosed in metal cabinet. A fine wire mesh is required in front of an arc lamp to prevent sparks from flying to the scenery. Exit lights are kept burning during the whole of the performance and are controlled independently of all house switches. In moving-picture theaters the arc lamp for the picture machine is enclosed in a large sheet-iron cabinet. The doors of the cabinet are held open and arranged to close automatically with cotton cord and fusible link.

Denver, he said, has been very fortunate in not experiencing any severe fire from this class of building. The films used in picture shows are very inflammable. Several serious fires with loss of life trace their origin to picture films. In the city of Old Mexico about a year ago 300 lives were lost in a theater where a special picture was being exhibited for the benefit of some high officials of the State. Only a short time ago an explosion occurred in a film factory which carried with it the loss of a dozen or more lives and the total destruction of the building. Mr. Reardon considers that too much caution cannot be used in the inspection of moving-picture theaters.

Electricity in Buffalo Churches.

For many reasons lighting by electricity is favored by churches. Central stations also look upon this business in a favorable way as the energy is used mainly on Sundays when mercantile establishments are closed. Besides lighting the interior, churches now use electric signs and other electrical decoration outside. Most large churches having pipe organs also use motors for pumping the organs, and some use them in connection with the ventilating systems. Of the 200 churches in Buffalo, 78 use electricity. All new churches are now wired. The Buffalo General Electric Company supplies energy to 60, one gets energy from a downtown office building, while the others have private plants. St. Ann's and Corpus Christi churches have the largest plants, the first having two dynamos of 35 kw and 15 kw, respectively, connected directly to two gas engines, a one-story concrete building in the rear of the church being used to contain this equipment. At this church two motors, one 5 hp and one 7 hp, are used. The electrical equipment installed in Corpus Christi, which has just been completed, consists of two direct-current generators, one Allis-Chalmers 30-kw directly connected to a 55-hp Bruce-Meriam-Abbott Company's vertical, twin-cylinder gasoline engine, and one 9-kw Bruce-Meriam-Abbott unit driven by a 15-hp vertical twin-cylinder gasoline engine. The gasoline is kept in a buried tank, about 15 ft. from the building, and small pumps on the shaft of the engines are used to draw it as needed. The engines are started by air, a 1-hp motor being used to run the compressor. In a separate fireproof room a storage-battery equipment is located. The rear of the basement of the church is used for the plant and it is the intention also to supply the rectory, convent and parochial school with electricity.

Large Electrical Sign on an Atlanta Dry Goods Building.

BY S. MAYS BELL.

The sign as shown in the accompanying photograph was recently erected on the top of the building of the Bass Dry Goods Company, Atlanta, Ga. The monster "B" in the picture is the first of four letters which complete the word "Bass." When the lights were first turned into the great sign in the middle of September last—over 250 electric lamps in full glow—the sign was easily visible 20 miles away from Atlanta. The sign in Atlanta can be easily seen and read in Marietta, Decatur, Lithonia and other suburban towns within an average radius of 20 miles away.

The sign as shown in the picture is composed of only four letters, but each letter is 12 ft. high and the width of the single word, B-A-S-S, is nearly 50 ft. The "B" letter itself contains 77 electric lights. The stem of this letter is 14 in. wide. It occupies 8 ft. of space and fills a total area of 64 sq. ft. The bottom of the letters in the sign is 30 ft. above the roof of the building. The sign itself is erected upon a steel frame which can be seen in the picture.

VIEW OF ELECTRIC SIGN COMPOSED OF 12-FT. LETTERS, IN ATLANTA, GA.

The sign was erected and equipped for the Bass Dry Goods Company by the electric sign department of the Georgia Railway & Electric Company, of Atlanta. It was made in Knoxville, Tenn., by the Greenwood Advertising Company, to whom we are indebted for the photograph used. Thirty days were required for building the sign, which was shipped to Atlanta in a specially constructed furniture freight car. For the present the sign is burning with a steady light, but it is so wired that flashes may be used.

There are two capital letters of a sign in Memphis, Tenn., which are larger than these letters in Bass' sign, but with this exception, the one here illustrated is the largest in the South.

Mr. F. H. Lansdell, electrician of the Georgia Railway & Electric Company, Atlanta, together with a force of seven skilled electricians, were busy for five days in putting this sign in place and completing the wiring. Of course, there are many larger signs in the East and North, but nothing in the South as yet that can touch Bass' sign.

Electrical Inspection.

At the recent meeting of the Western Association of Electrical Inspectors, Mr. Alex. Henderson, of New York, gave an interesting address on "The Influence of Inspection Upon Manufactured Electrical Appliances," in the course of which he traced the history of electrical inspection from the earliest days. Electrical inspection appears to date from the spring of 1881, when a conference was held in New York between representatives of the fire insurance interests, the Western Union Telegraph Company and the Brush Electric Illuminating Company. One of the results of the interview was that electric light wiremen in New York City received stringent orders to stop the use of double-pointed tacks in putting up conductors. The first printed rules were issued by the New York Board of Fire Underwriters under date of Oct. 19, 1881. These rules consisted of only five paragraphs, and among the provisions were that wires should have "50 per cent excess of conductivity above the amount calculated as necessary for the number of lights to be supplied by the wire"; and that incandescent light wires should be placed 2½ in. apart, and arc-light wires 8 in. apart. Early in 1882 the Boston Manufacturers' Mutual Fire Insurance Company issued several rules on wiring, one of which provided for a separation of 1 ft. between conducting wires, and ⅛ in. to ¼ in. between conductors and adjacent walls, ceilings, etc. These rules also specified that "soldered joints are desirable but not essential."

In 1882 the first rubber-covered wire was used in New York for a day circuit on a pole line, but in the course of a few months the insulation was hanging from the wires in long shreds, and the conductors were replaced with the older "Underwriters' wire." The work of changing conductors went on while the circuit was alive, the voltage being 1800; and while the workmen learned to expect a kick every time a new section of wire was cut in, everything went along smoothly until within a day or two of the completion of the job, when one of the wiremen was killed. This was the second serious electrical accident on record, the first having occurred in February or March of that year in Pittsburgh.

On one occasion it was necessary to run a circuit under water for about 75 ft. or 100 ft., and three different cables ordered from manufacturers lasted from 6 to 10 days each. A cable was then manufactured by stretching No. 6 copper wire tightly between two poles, then parceling it with a layer of white cotton laid up in shellac and covered with friction tape, which process was repeated three times on each wire. They were then paired and treated as before, and connected to a circuit carrying at first 720 volts and later 2700 volts. Twelve years later this cable was still in successful use.

Prior to 1889 the New England Insurance Exchange and the New York Board of Fire Underwriters placed electrical inspectors in the field, and following 1891 many municipalities created inspection organizations, and underwriters' inspectors began to appear throughout the country. Difference of opinion soon arose between the underwriters and contractors; insurance interests in one section were not in full accord with those in another; some municipal bureaus and underwriters' departments attempted to create and enforce rules of their own and in many cases insurance and municipal authorities failed to agree upon interpretation. These chaotic conditions were finally taken in hand in 1895, when insurance men came to the rescue and invited a number of competent authorities to meet them in conference, and a year or so later published the national code.

Referring to the present status of electrical inspection, Mr. Henderson said that whereas formerly the electrical inspector depended largely on what scraps of information he could gather from the wiremen and others whom he found on the job, he now enters the field, usually as a graduate from some competent school of electrical engineering, spends a short time familiarizing himself with the practical side of electrical construction, and when he finally takes up the real inspection work he finds that he is backed up by one of the most complete systems of testing and inspection that can well be imagined; and when he discovers he is short of information he has but to communicate through his headquarters with the Underwriters' Laboratories, where he is in immediate touch with the best engineering talent.

Mr. Henderson says that such a process of evolution from the days of the double-pointed tack to this age of porcelain and steel could not have been accomplished in so short a time without the spur of electrical inspection.

Street Arches at Norfolk, Va.

The continuous and united efforts on the part of the merchants and property owners of Granby Street, Norfolk, Va., to do something which would contribute to its realty and mercantile value gave conception and birth to the Granby Street White Way, the success of which could no longer be doubted by the sceptical and non-progressive merchants, when, a month or more ago, this popular, but poorly lighted, thoroughfare was converted into one of the best and most artistically lighted streets in any city south of New York. The crowds that gath-

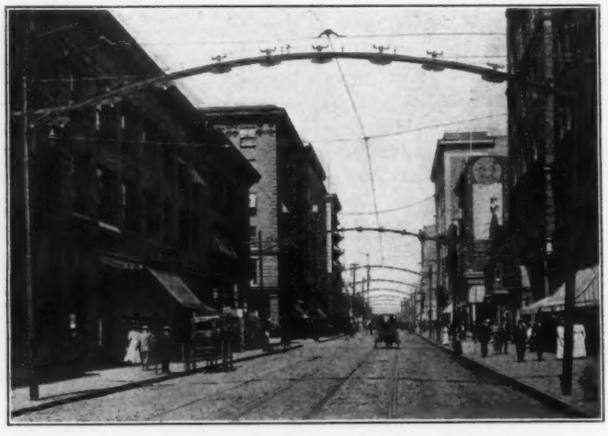


FIG. 1.—GRANBY STREET, NORFOLK, VA., BY DAY.

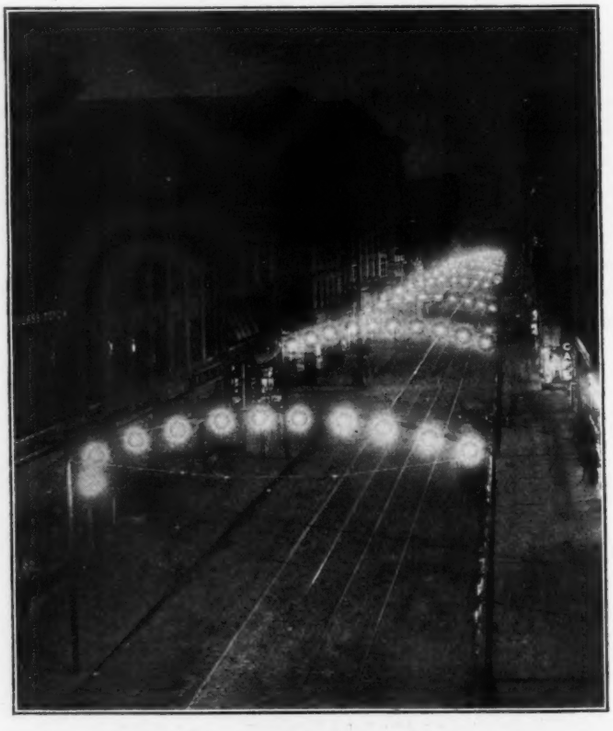


FIG. 2.—GRANBY STREET, NORFOLK, VA., BY NIGHT.

ered to witness and welcome the success of this enterprise were only larger during the busiest period of the Jamestown Exposition.

As a result of several informal conferences and interchanging of ideas as to the value of such a movement, a meeting was called and two committees of two members each were appointed from the merchants and real-estate owners to investigate and report the possible resources. After a careful investigation as to the number of merchants and the owners of the property in the district to be lighted, a report was made and each merchant was assessed $60 and each realty owner 50 cents per front foot. A prospectus, setting forth that the subscription was to cover construction work and maintenance for one year. was prepared for each committee. There was much disappointment over the response of the property owners, but the merchants responded nobly.

When all resources had been exhausted, the committee found itself several hundred dollars short of what appeared to be the lowest possible price, and it was largely due to the liberal spirit with which the Norfolk & Portsmouth Tarction Company met the committee, that the Granby Street White Way was finally made possible. As a protection to each subscriber against a possible liability beyond his subscription, the "Granby Street White Way" was incorporated and subscribers' stock certificates were issued for the number of shares at a par value of $1 per share.

Many suggestions as to the design of construction were discussed, but the one submitted by Mr. R. S. Scott, the illuminating engineer of the Norfolk & Portsmouth Traction Company, and his associate, Mr. A. J. Amm, of the General Electric Company, was accepted. Flat steel arches, with a span of 40 ft., width of 12 in. and a rise of 4 ft., were placed across the street attached to the iron railway poles located every 100 ft. The arches were made up of two 2-in. x 3-in. angles, rolled to the proper radius and laced together. A ½-in. steel span wire was run over the arch from top to top of the supporting poles and a messenger dropped to the arch to take care of wind strains. Ten General Electric series-incandescent center-span suspension outfits were attached to a ½-in. steel cable run 12 in. above the top of each arc hand supported by I-bolts fixed to the lacing. The lamps were thus protected from any violent shocks which the arch might receive and still the structure possessed the necessary element of rigidity. The lamps and reflectors alone hang below the arch, and the whole presents a very attractive appearance in the daytime. Twenty-seven such arches were placed between Main and Bute streets, each arch having 10 60-cp, 75-watt, 6.6-amp General Electric street-series lamps with automatic cut-outs and radial-wave reflectors. The neat yet substantial design, the graceful and symmetrical curve of the arch and the regularity and the adjustment of the lamps have created a comment which indicates that the public is highly pleased and reflects much credit upon the engineers. That the merchants are pleased is proved by the fact that the business men of Main Street and those of Church Street have taken steps to makes these thoroughfares more attractive. The arches were made and erected by the Etna Iron Works, a local concern, for $45 each.

Norfolk is a city from which radiate eight railroad systems, having a total mileage of over 25,000 miles in all directions, and 20 steamship lines to the North, South and East. The population of the city has increased from 22,000 in 1880 to 120,000 (including suburbs) in 1909. The city's marine tonnage exceeded that of New York Harbor in 1908, and it is the largest coal exporting point in the Western Hemisphere. Norfolk is fast becoming a great manufacturing center. Electricity for all purposes is generated by the Norfolk & Portsmouth Traction Company in a magnificent $1,500,000-power station, capable of an output of 11,000 kw, minimum, which is distributed to the consumer from six modern substations. The company operates 143 miles of electric railway, and brings the remotest suburbs within a few minutes of the central business section. Its overhead and underground transmission lines cover an area of 150 sq. miles.

New Telephone Patents.

NEW TRANSMITTING DEVICES.

The microphone as a physical laboratory instrument has been studied very thoroughly, and our present transmitter is to a considerable extent the outgrowth of laboratory work. It was early discovered that there was but a small distance through which microphonic action takes place. This distance had different values as the substances in contact varied. Carbon has a very large microphonic distance.

It has also been found that the microphonic action varies with the medium filling the space about the contact for telephone working, it of course always being essential that this medium be a gas or in the gaseous state. Messrs. C. E. Egner, of Stockholm, and J. G. Holmström, of Saltsjöstorangen, Sweden, have applied the use of such media to the telephone transmitter. According to their joint patent, the air must be exhausted from the transmitter, or partially so, and there must be substituted some other gas—preferably hydrogen or a hydrogen compound, which of all other gases gives the maximum microphonic action. The transmitted must then be sealed.

Another transmitting instrument, the invention of Mr. C. D. Babcock, of New York City, depends upon a different physical phenomenon, namely, the property of some substances of great changes of resistance relative to temperature, provided the substance be at a certain critical temperature. It will be seen that if the telephone currents generated by the transmitter can be made to affect the temperature of the sensitive substance a multiplied resistance change will occur in its local circuit. Mr. Babcock's patent is assigned to the United Wireless Telegraph Company.

NEW APPARATUS.

With certain types of selective signaling systems of wiring it is necessary to give a "bias" by means of springs applied to the armature. Mr. N. P. Jenson, of Waterloo, Ia., has now conceived the idea of making the cores of the ringer magnets hollow and concealing in each a spiral wire spring. These wires project against the armature ends and their tension is

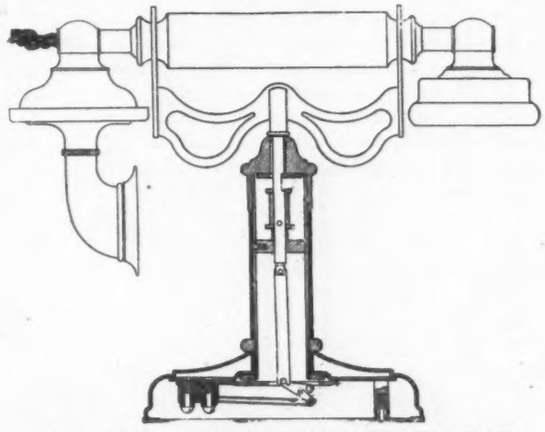


FIG. 1.—WEISS SUPPORT FOR HAND MICRO-TELEPHONE.

adjusted by means of screws bearing down from the yoke end of the cores upon the upper ends of the springs.

Mr. W. K. Howe has patented a combination telephone circuit with a low-inductance relay of a special type in circuit. The relay core has two limbs, each carrying one coil and each coil included in one side of the circuit. A copper shell is inserted between the core and the winding, which, acting as a short-circuiting secondary, cuts down the reactance of the winding proper.

In Fig. 2 is shown an instrument support for use with the hand micro-telephone. The head of the apparatus is elevated by a spiral spring about the stem, except when this latter is overpowered by the weight of the instrument. It will be seen that the spindle drives the switch springs with considerable leverage. This support is the invention of Mr. A. H. Weiss,

of Chicago, Ill., the patent being assigned to the Kellogg Switchboard & Supply Company.

Mr. E. A. Metcalf, of Forbes, Mo., has devised a combined desk-stand set and receiver support. A projection of the stem beyond the transmitter lug carries the support for the receiver arm. This latter is so shaped and supported that swinging it about a horizontal axis causes the receiver to be presented to either ear of the user. A ring sliding on the stem tube controls the switch springs. A spring impels it upward to the normal position. A latch holds it in the talking or depressed position when required.

Mr. C. S. Coom, of Rockledge, Pa., is the inventor of a different type of set of the same kind. In this the switch lever

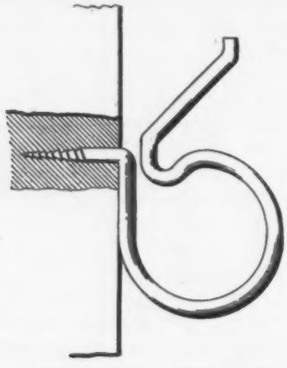


FIG. 2.—WILSON WALL DISTRIBUTING RING.

is made part of the receiver support, and a toggle lever coacting with it, serves to hold the lever in the "up" position when required for conversation.

A bridal and cable ring is the invention covered in a patent granted to Mr. J. H. Wilson, of Rome, Ga. The ring is formed of a single piece of wire, and has the form shown in Fig. 2. It will be seen that there is space for cable and wires in the ring and additional wires in the "V."

PARTY-LINE APPARATUS.

A very interesting party-line system of the step-by-step type has been patented by Messrs. F. J. Mersman and Joseph Mersman, of Ottawa, Ohio. A central-office operator does the selection by the use of impulses of current of two strengths. A low-voltage impulse actuates a stepping mechanism only while a high-voltage impulse actuates it, and in addition a cut-off switch. For example, one high-power impulse advances all stations one notch, and at No. 1 station the cut-off switch is not blocked, and it, therefore, operates to clear the station from the line. All other cut-off switches are blocked, a second high-power impulse advances all stations and cuts off No. 2. A low-power impulse advances all stations, but fails to cut out any station, hence the selection. It will thus be seen that any desired set of stations from one up may be left in and all others locked out. Means are also provided by a block mechanism for synchronizing all stations by a series of low-powered impulses, stepping all forward by the block, and thus into action with a single high-powered impulse.

Letters to the Editor.

Errors in Testing Sources of Light.

To the Editor of Electrical World:

Sir:—The writer has read with much interest the editorial on "Errors in Testing Sources of Light" in your issue of Oct. 14 and Mr. Carl Hering's letter in regard to this editorial.

The matter of rigor in engineering mathematics is emphasized in the editorial. In effect, the question is broached, Is it necessary or even advisable to seek for a rigorous method where rigor can only introduce complications into the results that may vitiate their practical utility, particularly where the agreement between the calculated and actual results must of necessity be approximate? The writer believes, and his belief is borne out by practically all writers on the mathematics of engineering, that rigor is generally of academic value only. Mathematics is common sense expressed in shorthand, and just as we find non-grammatical idioms so much more generally useful in every-day life than well-thought and polished periods, so in the practical application of mathematical physics we often find the shorter and less elaborate treatment of non-rigorous abstraction of greater pragmatic value.

It is not necessary to consider the fact that a so-called linear light source has body, if the results obtained by treating it as a mathematical line give results reasonably close to the actual illumination produced. The question is, Will the more complex and rigorous investigation give results that agree more closely with the necessarily approximate results of measurement? So with surface sources. Can we gain any practical advantage by taking into consideration the fact that the body of the source emits some of the light that eventually radiates from the bounding surface and that the cosine law is not an accurate statement of conditions; or is it sufficient to consider for the sake of conciseness that all the light is emitted directly by the bounding surface, and that the cosine law holds for surface elements?

The answers to these questions cannot be supplied by any such blanket clause as the editorial contains—they can be answered only by a study of the nature of the results desired and a proper proportioning of means to ends. We know that even so great a mathematician as Maxwell threw rigor to the winds where his insight showed him the less tedious path. To Heaviside rigor was a bugbear. It will be justly said that in certain cases Maxwell's inrigorous analysis gave results that lacked the generality they were later found to possess. But from the standpoint of what he wanted to show his analysis was ample and its abstraction justified. All mathematics deals with abstractions. It selects the features of the problem important for the end in view and ignores everything else that is not immediately related to the underlying motive. If it did not follow this process it would be impossible for any human brain to encompass the solution of even a comparatively simple problem.

It must be understood that this is not an appeal for carelessness in mathematical work. In most important cases it takes the keenest insight to sift out the inconsequential factors—a work entirely preliminary to the statement of the problem and not fully realized because never written down. Involved work is almost a certain indication of poor ability and is generally due to the inclusion of unnecessary elements.

Mr. Hering's method as evidenced in his paper is perfectly adequate and proper when we consider the results he sought. His method of abstraction is perfectly legitimate when looked at from his conclusions, but may seem incorrect when looked at from other conclusions derived by a more complete method but with an entirely different end in view.

Theoretical correctness is all very well in its place, but it has no place in any branch of applied physics where all results are inherently approximate. The man who breaks the bank at faro depends entirely on his native practical judgment of conditions. He who guides himself solely by the mathematical laws of probability comes away with empty pockets.

The editorial also speaks of "the application of mathematics" to physics somewhat as if mathematics were a sort of paint that can be applied in coats. I do not mean to split hairs as to the meaning of terms. But is it not true that it is in just the attitude expressed by these words where lies the principal shortcoming of most mathematical teaching? One can no more analyze a given set of conditions by applying mathematics to them than one can produce the outcome of a given set of situations in the form of a story by applying the rules of grammar. Grammar may aid us in giving suitable expression to the thoughts aroused by the situations. So mathematics can only aid us in expressing the logical concurrence or sequence of events following the occurrence of certain physical conditions. The defect of attitude mentioned above is a legacy of "pure" mathematics carried over into practical work. It produces the

same sort of pedantic reasoning that we find in the writings of grammarians.

Finally, the writer cannot see any present practical value to be attained by introducing the idea of volume into the study of light sources that is not entirely offset by concomitant complications.

NEW YORK. BASSETT JONES, JR.

[In organizing the body of knowledge pertaining to a branch of science, no principle can be rejected, even though at the moment it may appear to have little or no commercial or practical bearing. Each may then extract from the complete body for practical application only so much as may suit his needs. The stub end of a tallow dip rescued from an ash-barrel may suffice for practical illumination measurements, while in the absolute comparison of sources of light, no principle involved can be ignored, and no refinement in method can be too great. As to our correspondent's mathematical discursion—which appears to proceed from a complete misunderstanding of the editorial commented on—while his remarks may apply to the use of mathematics by amateurs with reminiscences of text-book instruction on the subject, they appear to have no bearing on the value of this powerful weapon to physical science and to engineering, when wielded by those skilled in mathematical analysis and cognizant of its limitations as fixed by the conditions of a problem, as well as of its potency within such limits. Our correspondent appears to construe the recognition of these principles by great masters of mathematics like Maxwell and Heaviside as evidence of "inrigor" on their part. Rigor is a relative term and should be construed for each case of analysis, and not condemned for its disparity with, for example, "non-grammatical idioms."—ED.]

Polyphase Magnetomotive Forces.

To the Editor of Electrical World:

SIR:—In Mr. Henry Hermann's letter in your issue of Oct. 14, discussing a paper entitled "Polyphase Magnetomotive Forces" which appeared in the issue of Aug. 26, several statements are made to which the undersigned must take exception.

The equations given in the letter are in common use for obtaining the effective value of an alternating wave in which harmonics occur; Mr. Hermann's attempt to use these equations for obtaining the counter e.m.f. of an induction motor is probably based upon the assumption that the harmonics in the motor flux-wave give rise to similar harmonics in the counter e.m.f. wave—just as, in the case of an alternator, the "single conductor e.m.f." contains all the harmonics of the field. This assumption is incorrect; in an alternator the whole field, harmonics and all, moves as a unit in one direction, but in the induction motor each harmonic component of the field moves in its own direction at its own speed. The effect of this action may be seen by a consideration of Fig. 1, which represents the fundamental and third harmonic fluxes in a two-phase motor with full-pitch concentrated winding at the instant when the current in one phase, B, is zero. These fluxes move in opposite directions, as indicated by the arrows, and the speed of the third harmonic flux is one-third of that of the fundamental.

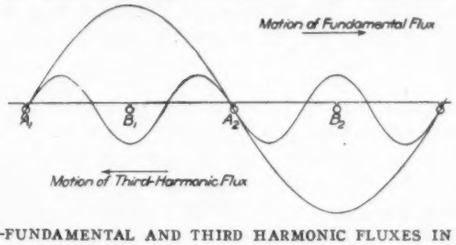


FIG. 1.—FUNDAMENTAL AND THIRD HARMONIC FLUXES IN A TWO-PHASE MOTOR.

At the given instant conductors A_1 and A_2 of phase winding A are without e.m.f. In phase winding B conductor B_1 is being cut by the positive half-wave of the fundamental flux moving toward the right hand, and by the negative half-wave of the third harmonic flux moving toward the left hand; the two resulting e.m.fs. are, therefore, of the same sign. An instant later conductor A_1 will undergo cutting by the negative half-wave of the fundamental moving toward the right hand, and by the positive half-wave of the third harmonic moving toward the left hand, and the e.m.fs. will be again of like sign Moreover, the two e.m.fs. will have the same frequency, since a half-wave of the third harmonic cuts a given conductor in exactly the same time as is required by a half-wave of the fundamental.

This proof may be generalized, and it will then appear that in a motor having any number of phases and any distribution or pitch of winding, the counter e.m.f. due to any flux harmonic is always positive in sign, of fundamental frequency, and adds directly to the counter e.m.f. due to the fundamental flux component. It is obvious, therefore, that Mr. Hermann's equations are not applicable in this connection.

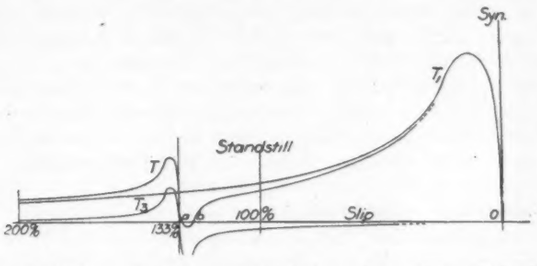


FIG. 2.—TORQUE DUE TO FUNDAMENTAL AND THIRD HARMONIC FLUXES.

Several errors occur in the diagrams given by Mr. Hermann for explaining the phenomenon of a two-phase motor running against its field; backward running is confused with negative slip, and the direction given for the rotation of the third harmonic flux component is wrong. Mr. Hermann has treated this harmonic as if it rotated forward, and has placed the point of third harmonic synchronism at 66.6 per cent slip instead of 133.3 per cent, where it properly belongs. The correct representation is given in Fig. 2, in which curve T_1 gives the torque due to the fundamental flux, curve T_3 the torque due to the third harmonic flux, and curve T the combined torque of both. To simplify the diagram harmonics of higher order are left out. Between points a and b the total torque T is negative, which means that within this range of speed the motor exerts torque in a direction opposite to the motion of the fundamental flux.

If the motor is brought up to synchronism, and the connections of one phase winding are then reversed, for the instant the slip will be 200 per cent, which means full speed backward. The load torque, fundamental torque and third harmonic torque combine to bring down the speed to a point slightly under 133.3 per cent slip, not far from point a. As the slip passes the 133.3 per cent value, the third harmonic torque reverses, and thus at point a the third harmonic torque acts against the fundamental torque, and tends to keep the rotor running backward. The speed cannot go much below this point unless the fundamental torque plus the load torque is greater than the pull-out torque of the third harmonic; if not, the motor will keep this speed indefinitely, running "against the field." If a load is put on which requires a torque equal to or greater than the negative maximum of curve T between points a and b the motor will be enabled to reverse, the speed falling to zero and rising to synchronism in the reverse direction—that is, "with the field."

This phenomenon does not exist in two-phase motors when the third harmonic is wiped out more or less completely through the use of fractional pitch. In three-phase motors the fifth harmonic produces effects similar to those produced by the third harmonic in two-phase motors, but in lesser degree on account of the comparatively smaller value of the fifth harmonic.

CHICAGO, ILL. JOHN D. NIES.

Commutation in Direct-Current Machines.

To the Editor of Electrical World:

Sir:—Your issue of Sept. 2, page 563, contains an abstract (page 563) of Rüdenberg's paper in the *Elektrotechnische Zeitschrift*, wherein it is said that "the article is an advance on the usual theories of commutation in so far as it considers the important part played by the paths in parallel with the armature coils as they leave short-circuit." This assertion of Rüdenberg's is positively inexact, for the important part played by the paths in parallel was for the first time discussed in my article in the *Elektrotechnische Zeitschrift*, 1906, page 1127. Therein I proved that when the *true* "paths in parallel" which exist *in reality* in the dynamo-circuit are taken into account, then the formula for the current density at the brushes never becomes infinitely great. The infinity criterion hitherto admitted and the dynamo theories based thereon, as, for instance, Arnold and Rüdenberg's theories, are therefore certainly untenable.

Rüdenberg's recent article is, however, in so far essentially different from mine that Rüdenberg now *assumes fictitious paths* in parallel with the armature coils, to which he ascribes a fictitious *constant* resistance, while I have taken into account the *really existing bypath in the dynamo circuit with its essentially variable resistance during commutation.* That Rüdenberg arrives again at the infinity criterion is, therefore, merely a consequence of certain mathematical formulas, so arranged as to conduce to that result; but this does not represent a peculiarity of *the real, of the actual existing dynamo.*

A discussion of the question, with a reprint of my original paper from the *Elektrotechnische Zeitschrift*, has been published on pages 10-21 of my pamphlet "Kommutierung, Kompensierung und Wendepole," which, together with a reprint of my paper from *The Electrician*, of London, 1908, Vol. LX, page 719, as an introduction to it, may be consulted at the library of the American Institute of Electrical Engineers, New York.

Scheveningen, Holland. C. L. R. E. Menges.

Formula for Cost of Steam Heating.

To the Editor of Electrical World:

Sir:—In studying the very valuable articles on exhaust steam heating in the issue of Oct. 7, I find that on page 830 in the formula $C = 0.2\,S \div e$ the value of C is not fully given. Does it mean tons of coal per heating season or for some other period of time?

Philadelphia. James A. Brown.

[The formula in question is based on the use of live steam for heating. Expressing its terms in more amplified form, C = tons of coal required per heating season; S = square feet of glass surface plus 1/10th of the wall and roof surface, while e = number of pounds of steam per pound of coal. It may be added that the factor 0.2 is based on the average temperature in Chicago, and should probably be modified if the formula were to be used in Philadelphia, where the average winter temperature is probably somewhat higher than in Chicago. The proportion could be arrived at approximately by ascertaining the mean winter temperature in Philadelphia and comparing it with the corresponding temperature in Chicago.—Ed.]

Machine vs. Manual Telegraphy.

To the Editor of Electrical World:

Sir:—We desire to thank you for publishing in your issue of Oct. 21 my letter relative to the results attained by this company in its experimental trial of the Rowland printing telegraph, although it was sent you in the belief that a full and fair statement on the subject would be of interest to your readers, and therefore worthy of space in your columns.

It is stated in a note commenting on this letter that—

"Until our telegraph systems are radically reorganized from top to bottom on the basis of machine telegraphy, and manual telegraphy is finally consigned to the tomb that has been yawning for it for the past 30 years or more, the telegraph industry will continue to lag far behind all other electrical development. Almost necessarily machine telegraphy 'cannot be conclusively advantageous under present traffic-handling methods.'"

These remarks evince comprehensive ignorance of telegraph requirements and methods. It is hard to believe that the responsible editor of any electrical paper would be willing to acknowledge authorship of them. I do not desire to make them the basis of a controversy.

But if, by any possibility, any of your readers should be disposed to take them seriously, I trust that they will not be accepted as conclusive. It is a fact that machine telegraphy is not now adaptable generally to the requirements of telegraph systems in the United States; it is a fact that the telegraph industry does not lag far behind all other electrical development, and it is a fact that the present traffic-handling methods in this country are efficient and the best that have so far been devised.

New York, N. Y. Chas. P. Bruch.

The Light of the Fire Fly.

To the Editor of Electrical World:

Sir:—I have read with interest the report of the I. E. S. convention and the editorial on the fire fly in your issue of Oct. 14. You may be interested in the fact that several species of the fire fly are very abundant here and may be seen by hundreds on the city parking and lawns, while in the open fields it is no exaggeration to say that they may be found by the thousands. They abound during July and August, and their departure is as sudden as their arrival. They must have impressed Professor Langley deeply, and no doubt he would have devised methods for studying them if it had not been possible to obtain the Cuban genus, which emits a continuous glow.

The consideration of the problem of measuring radiometrically the energy emitted by these insects has interested me for several years, and with reference to your editorial a few remarks on the difficulties involved may be of interest. The sensitiveness of the radiation meter must be so high, while the physical strain to handle it is so great, that one familiar with these instruments does not undertake problems, such as the one on the fire fly, without first trying to gain the information indirectly, even if it is not so convincing. Measuring the light from stars or of the fire fly is more or less spectacular and appeals to the mind where many laboratory experiments, requiring equal delicacy of measurement, go unnoticed.

To give you some idea of the sensitiveness of the instruments required for measuring these weak radiations, I would state that the sensitiveness of the radiometer used in measuring the heat from stars was about one-fourth that used in measuring the spectral distribution of energy from gases in vacuum tubes. For the vacuum-tube measurements 1 mm deflection on the scale represented a rise in temperature of only 1/200,000 deg. There are a few reliable records of work with instruments sensitive to 1 mm deflection = 1/1,000,000 deg. On several calm, cloudy days, with window blinds closed and doors bolted against possible visitors, the writer found it possible to work with a sensitiveness of 1 mm deflection, equivalent to seven-ten-millionths degree; the time required to obtain an observation being about one minute. In ordinary routine work difficulty is experienced when using a sensitiveness of 1/50,000 deg.

From the foregoing comments it is evident that there is no hope of obtaining reliable quantitative measurements on the fire fly with instruments less sensitive than 1 mm deflection equal to one-millionth deg., which will require a half minute or more in which to get an observation. It is evident that only an insect emitting a continuous glow can be investigated radiometrically. The photographic method (a happy thought of Dr. Ives) is preferable since it gives us a more reliable record of the energy distribution in the visible spectrum, and, incidentally, it answers

the question whether the spectrum is simply one of low intensity—which it is not. It cannot tell us whether there is infra-red radiation. However, there are data available from which we can form some estimate of the improbability of emission of energy outside of the visible spectrum. The color of the emitted light varies from green to yellow and red (the latter is very rare I am told by Dr. Swartz, of the National Museum) which may be due to absorption in passing though the chitinous layer. While it would evidently be poor economy for (hence not to be expected) these insects to produce light covering a wide range of the spectrum, and then absorb all but the part observed, it was of interest to examine into this question. Through the courtesy of the National Museum I was recently enabled to examine several species of elaters from Cuba and Guatemala, which emit a yellow-green light.

In all cases, including our native genus of fire fly, the outer integument covering the insect, the chitinous layer, was found to be perfectly transparent in the regions covering the luminous organs, while elsewhere the integument was a deep reddish brown. From this it is evident that the color of the emitted light is not due to absorption in passing through the chitinous layer, and that it is the sum total of all the light coming from the photogenic cells. While the photographic plate shows that the light is not subjective due to low intensity, the transparency of the integument indicates that if red light had been present it could have passed out into space. Of course, this does not settle the question regarding the possible absorption of certain waves in the photogenic organs themselves; but why do we expect to find that the generation of the emitted light must be accompanied by a generation of radiant heat? We might as well suppose that the combustion of food in our bodies (with the resultant formation of CO_2 and H_2O) or that the combustion in a growing plant leaf must be accompanied by a rise in temperature and emission of radiant energy (other than "animal heat") because we observe the latter phenomenon when we light a candle or heave coal into the fire.

But let us suppose that the fire fly does generate heat waves in his photogenous organs. Then what is the probability of these waves getting out into space? It is an observed fact that the more complex the organic compound, the more opaque it is to heat waves, especially of wave-lengths greater than 2μ. The chitinous layer is chemically more complex than any substances yet examined for transparency in the infra-red. In addition to this, water is also very opaque to radiation beyond 1.5μ in the infra-red. The presence of the two makes it quite certain that no heat waves greater than about 2μ can pass out of the insect, even if produced in the photogenic cells. If infra-red emission bands are found they will in all probability be due to selective absorption of the chitinous layer. The radiation from the insect due to its natural body temperature, "animal heat," must have its maximum radiation at 8μ to 10μ, so that instead of attempting to confirm Langley's observations on the infra-red radiations, as suggested in your editorial, the problem is to search the spectrum at 1μ to 2μ. As a first approximation find the radiation from the fire fly, using a piece of clear glass to absorb the radiation beyond 3μ, the "animal heat," and then absorb the visible radiation by means of Schott's red glass, which is unusually transparent at 1μ to 2μ.

Considered as a whole, it seems to me that the difficulty lies in our knowledge of the fact that in many cases the emission of light is accompanied by the emission of heat waves, and in our expectation to find similar conditions to obtain in the fire fly. If such conditions did obtain, and if the radiant heat were present in the proportion that it is in the Hefner flame or in carbon dioxide in a vacuum tube, judging by the intensity of the visible radiation emitted by the fire fly, it is safe to say that if such a vast amount of heat waves were absorbed without doing internal work, the rise in temperature would be such that his life would be speedily ended by desiccation. To produce radiant energy of long waves, only to absorb it, seems a cumbersome operation, because of the high mechanical equivalent of heat waves (energy comprised between λ_1 and λ_2), such as commonly observed in the spectral radiation from solids.

The fire fly's light stops abruptly in the red, and its spectral-energy distribution is similar to that of fluorescent light (see observations of Nichols and Merritt) which is generally a transformation *downward* from an excitation of shorter wave-length. Why not credit the fire fly with a step-down process of excitation, the resultant (emitted) waves being similar to our common fluorescence spectra, as observed? In this connection papers by Watase (Biological Lectures, 1895, Marine Biol. Lab. Woods Holl) may be of interest to readers of your journal.

WASHINGTON, D. C. WM. W. COBLENTZ.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Cost and Efficiency of Electrical Machinery.—L. CROUCH.—An article giving diagrams of the weight, speed and cost, efficiency and power factor of direct-current and alternating-current generators and motors, which may be taken as typical of modern design. Two of these diagrams are given herewith.

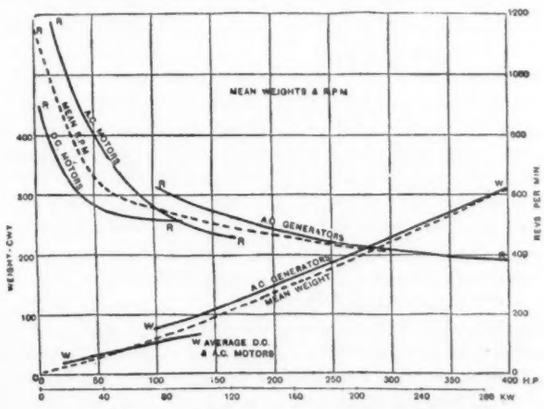


FIG. 1.—WEIGHT, SPEED AND OUTPUT.

The curves R in Fig. 1 give the r.p.m. and the curves W the weight as a function of the output. The curves in Fig. 2 give the total cost in pounds sterling and total cost per horse-power as functions of the output in the British market. The curves are otherwise self-explanatory. Similar curves are given concerning efficiency, power factor and slip.—Lond. *Electrical Review*, Oct. 22.

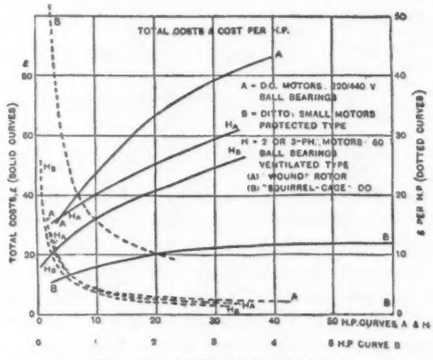

TOTAL COSTS & COST PER H.P.
A = D.C. MOTORS 220/440 V. BALL BEARINGS
B = DITTO: SMALL MOTORS PROTECTED TYPE
H = 2 OR 3-PH. MOTORS 60 BALL BEARINGS VENTILATED TYPE (A) WOUND ROTOR (B) "SQUIRREL-CAGE" DO
TOTAL COSTS £ (SOLID CURVES)
£ PER H.P. (DOTTED CURVES)
H.P. CURVES A & H
H.P. CURVE B

FIG. 2.—COST AND OUTPUT.

Iron Losses.—E. ROTHER.—Methods for determining the

hysteresis and eddy-current losses in iron in the stationary field cores of direct-current machines or in the practically circular rotary-field cores of polyphase induction motors have long been known. With the introduction of single-phase commutator motors, which are operating partly with pure alternating magnetic fields and partly with elliptic rotary magnetic fields, the determination of the iron losses in the field cores has become of importance. The author describes a series of experiments on this subject. In the present installment he describes the arrangement of the experiments and gives some of the results in form of diagrams. The article is to be continued.—*Elek. und Masch.* (Vienna), Oct. 17.

Direct-Current Generator or Motor.—A note on a recent British patent (20,098, 1908, and 72, 1909; Oct. 14, 1909, of A. Boeckel, O. Grünberg, J. K. Krukoviski and E. Luxembourg. The armature and field system are geared together and rotate at the same speed in opposite directions, while the brushes remain stationary. The number of commutator segments is twice the number of armature coils, each of which is connected to the two segments at opposite sides of the commutator. For a two-pole machine, four brushes are placed at right angles, the opposite brushes being connected together. If the field were to rotate at twice the speed of the armature, the commutator would have to be divided into three parts. The second specification describes a construction in which the rotary field is produced by means of a three-phase stationary winding receiving energy from the armature by means of slip-rings. The armature is connected to the commutator as above, and commutating poles projecting over an extension of the armature are provided. A compensating winding is also provided on the stator. The machine is applicable as a motor or a generator, and the high relative speed effects a reduction in the cost of material. —Lond. *Elec. Eng'ing*, Oct. 21.

Lamps and Lighting.

Electric Lighting.—L. Gaster.—A continuation of his Cantor lectures on modern methods of artificial illumination. He

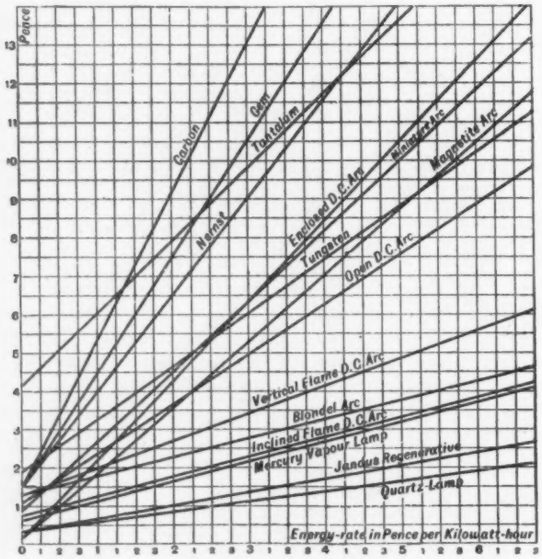


FIG. 3.—COMPARATIVE COST OF THE VARIOUS ILLUMINANTS.

compares the condition of the lamp industry in the United States with that in England, where there are many small makers, importers and dealers competing with each other, while the variety of pressure on lighting systems is "marvelous." The author emphasizes the good work done by the National Electric Light Association of the United States. He then reviews new developments in arc lamps and in vapor lamps, and finally gives, in a diagram, a comparative cost of the various illuminants. (Fig. 3.) The cost of renewal and maintenance is taken as $\frac{P \times 1000}{l \times L}$, where L means the mean spherical candle-power; l the life of lamp in the case of incandescent lamps; glower, in the case of Nernst lamps; electrode, in the case of arc lamps; vapor tube, in the case of vapor-tube lamps; P the price of bulb in the case of incandescent lamps; renewal of glower and ballast in the case of Nernst lamps; renewal of electrodes and trimming for arc lamps; tube for vapor lamps. He also gives the following comparison of the cost of gas lighting and electric lighting on the basis of figures of Blondel, assuming gas costs as 0.2 franc (4 cents) per cubic meter ($1.13 per 1000 cu. ft.), electricity at 0.7 franc (14 cents) per kw-hour:

			Incandescent electric lamps.			
			Carbon,		Tungsten,	
	Incandescent gas.		32 cp for 300 hrs.		32 cp for 1000 hrs.	
	Upright.	Inverted.	110 volt.	220 volt.	110 volt.	220 volt.
	Liters.	Liters.	Watts.	Watts.	Watts.	Watts.
Hourly consumption in watt-hours or liters	80	80	100	100	35	45
	Franc.	Franc.	Franc.	Franc.	Franc.	Franc.
Corresponding cost in francs	0.016	0.016	0.07	0.084	0.0245	0.0315
Cost of renewals per hour	0.0025	0.004	0.0017	0.003	0.0037	0.0062
Total cost of lighting per hour	0.0185	0.020	0.072	0.087	0.028	0.038
Mean spherical cp.	55	50	28	28	28	28
Cost per mean sph. cp per hour	0.00032	0.00040	0.00258	0.0031	0.001	0.00136

Assuming cost of gas 0.10 franc per cubic meter, electricity 0.70 franc per kw-hour.

Cost of gas consumed	0.008	0.008	0.01	0.011	0.0035	0.0045
Total cost, including renewals	0.0105	0.012	0.012	0.014	0.0072	0.0107
Cost per mean sph. cp. per hour	0.00019	0.00024	0.00043	0.0005	0.00026	0.00038

In the above table 1 franc = 20 cents; 1 cu. ft. = 28 liters. The following formula enables one to calculate running costs of electric lamps:

$$C = \frac{p}{TL_o} + \frac{p'W}{1000}$$

where p = cost of lamp, p' = cost per kw-hour of electrical energy, L_o = mean spherical candle-power, T = life before lamp is discarded, W = watts per mean spherical candle-power. —Lond. *Electrician*, Oct. 22.

Metallic-Filament Lamps.—A note on a recent British patent (19,847, Oct. 14, 1909) for lengthening the life of metallic filaments granted to the Glühlampenwerk Anker Gas. Blackening of bulbs can be prevented by admitting a small quantity of phosphoretted hydrogen or arseniuretted hydrogen into the vacuum.—Lond. *Elec. Eng'ing*, Oct. 21.

Generation, Transmission and Distribution.

Liquid Fuel.—J. S. S. Brame.—An abstract of a lecture on the economic aspects of liquid fuel. As a fuel for steam raising, oils of high calorific value, cheapness and high flash point are demanded, while for internal-combustion engines oils of high volatility are generally requisite in order that they may readily form explosive mixtures with air in the cylinder. The main advantages of liquid fuel over coal may be summarized as: Superior evaporation to coal in the ratio of 1.6 to 1; ease of handling; facility of stowing on ships in situations where coal could not possibly be stored; less space required than for coal, one ton of oil requiring only about 38 cu. ft., while coal requires about 43 cu. ft. per ton. The many advantages of liquid fuel have created such enthusiasm in its favor that the important questions of supply and prices have frequently been overlooked. The total oil supplies of the world, taking the figures for 1907, amounted to 34,569,500 tons, which in terms of coal, since it has such superior calorific value, would be equivalent to 51,854,250 tons of coal, or only one-fifth of the coal output of England alone. Further, only a portion of the crude petroleum is suitable for fuel. Liquid fuel, therefore, cannot compete with coal, and is not a fuel for general use, but for employment in special cases. For use in internal-combustion engines the lighter petroleum distillates are almost universally employed. England's annual importation of oil has now reached the total of about 33,500,000 gal. By the introduction of the spray carbureter a heavier grade of oil can

now be utilized, a factor of considerable economic importance as regards supplies. Moreover, since the calorific value of oils of varying gravity is practically the same per unit weight (20,000 thermal units) it follows that as they are bought by volume, the heavier grades are more economical. Paraffin-driven motors are valuable engines for many purposes, notably where a portable engine is required, or for boats where safety is a factor of great importance. Paraffin engines work best at constant speeds and are not suitable for cars. One important point with all engines using petroleum oils is that high compressions are out of the question, since at a little over 4.5 atmospheres there is a risk of premature ignition, hence the efficiencies obtained are low. As a substitute for gasoline, the claims for benzine (or benzol) and alcohol must be considered. The calorific value of benzine per unit weight is 18,540 thermal units, but per unit volume, owing to its higher gravity, it has a higher value than many oils. In practice, benzol gives most excellent results without any special alteration of the carbureter designed for oil. For motor use alcohol has many advantages over oil or benzine; it is far less inflammable, and if a fire does arise, it can more easily be extinguished; its combustion leaves no evil-smelling products; engines run more quietly on alcohol, and it will withstand higher compressions in the cylinder, thereby giving such greater efficiency that the effect of its low calorific value is almost counterbalanced. For equal weights, the calorific value of oil to alcohol is 20,000 to 11,000 thermal units—that is, a ratio of 1.8 to 1—but if considered by volume the ratio is reduced to 1.6 to 1. Since the thermal efficiency of alcohol is greater than oil in the ratio of 3 to 2, it is evident that, volume for volume, the same power can be obtained from alcohol as from petrol. At present the cost of alcohol is prohibitive, and it is unlikely that it can for many years reach the position of a commercial fuel.—Lond. *Electrician*, Oct. 22.

Refuse Destructor.—A note on the working of the refuse destructor plant at the Greenock electric central station, in England, during the last year. Sixteen thousand six hundred and ninety-eight tons of refuse were destroyed; the works costs amount to 48.5 cents per ton. The total number of kw-hours generated from the destructor steam amounted to 1,097,232 units, or 65.5 kw-hours per ton, and the value of the steam so supplied is put down as $8,000, or about 0.7 cent per kw-hour. From the figures that are given it would appear that the cost of fuel per kw-hour generated by coal is 0.4 cent. To this must be added the cost of labor, maintenance and capital charges on boiler plant. Whether this will bring the figure up to 0.7 cent, the price paid for the refuse steam, is perhaps doubtful, more particularly when it is remembered that the refuse steam is used on a plant running more or less on a 100 per cent load factor. What one really desires to know is whether the cost of generating these units beyond the cost of those generated by coal would have amounted to as much as the sum allowed for the refuse steam if they had been generated with the ordinary plant by means of coal.—Lond. *Electrician*, Oct. 22.

Cascade Induction Motor.—W. I. WILLIAMS-ELLIS.—An illustrated description of testing two 70-hp cascade-motor haulage sets for a British mine. The motors are connected to a 500-volt, 50-cycle, three-phase circuit, and as a drop in the line had to be allowed for, the machines were designed for a pressure of 485 volts. The chief advantages for the work are total elimination of slip-rings, with the full characteristics of a slip-ring motor. The windings on both stator and rotor are of a simple nature, and each machine is controlled through 12 tappings taken from the parallel windings of the stator and worked in pairs, each pair being finally short-circuited when the machine has reached approximately its final speed. Both machines are of the 12-pole type, while the air-gap is kept very short. Each of the above motors is connected through double-reduction gearing to a set of four drums, giving a rope speed suitable for roads laid in this class of quarry work. Efficiency figures of the electric machines are given as follows: Full load efficiency, 88.5 per cent; half-load efficiency, 87 per cent; 1.5-load efficiency, 89 per cent. The specified overload was 100 per cent; the actual overload developed on test was 110 per cent. Final temperature reached after 4.5 hours' run: stator winding, 62 deg. rise; surface of stator winding, 49 deg. rise; stator core, 67 deg. rise; rotor copper, 46 deg. rise; rotor core, 55 deg.—Lond. *Elec. Review*, Oct. 22.

Electric Motors in Steel Mill.—The electrical equipment of the Lanarkshire Steel Works includes provisions for electrical machinery of great variety, but the main mills are still steam driven. An interesting feature is the control of an electrically driven auxiliary hydraulic pumping plant. Energy for lighting is obtained from the company's own generating plant, but the supply for the motors is principally taken from the mains of the Clyde Valley Electrical Power Company.—Lond. *Elec. Eng'ing*, Oct. 21.

Steam Turbines.—G. STONEY.—The first part of abstracts of Cantor lectures on the subject of steam turbines. The author first makes a comparison with reciprocating engines, briefly describes several types of steam turbines, and then gives a mathematical theory of steam turbines referring to their coupling with electric generators.—Lond. *Elec. Review*, Oct. 15.

Gas Turbines.—E. K. SCOTT.—The author thinks that the gas turbine will finally replace the gas engine. He thinks that the gas-turbine problem is now being investigated in a haphazard fashion and should be investigated more systematically. He recommends that various institutions should combine and start a fund and form a gas-turbine research committee.—Lond. *Elec. Review*, Oct. 22.

Air Compressor.—An article giving numerical details of a test on an air compressor for a mine to determine efficiency and quantity of air compressed in a certain time.—*L'Industrie Elec.*, Oct. 10.

Traction.

Electric Traction Experiments in France.—A note on an electric locomotive designed by the Alioth Company for use on a section of the Paris, Lyons & Mediterranean Railway. Experiments are now being made on the Grasse-Mouans-Sartoux section, which is very convenient for the purpose, as it includes some of the steepest grades and the sharpest curves, and is also not crowded with traffic. The overhead wire is suspended flexibly by means of a system of the Alioth Company, which does not involve the use of separate suspension wires. Wooden poles are used at present, but these are to be replaced by metal lattice-work supports later on. The locomotive used weighs 140 tons, and it is approximately the same length (65 ft.) as the normal steam locomotive in use on the road, including the tender. There are eight axles, of which the four central ones are driving axles with large wheels. The overhead line is supplied with single-phase alternating current at 12,500 volts, but this is converted on the locomotive by means of a special permutator, devised by Auvert and Ferrand, into direct current at an e.m.f. adjustable between 0 volt and 600 volts at will. The motors are of the ordinary direct-current type of 450 hp each, and there are four to each locomotive. They are flexibly geared by means of spur gear to the four driving axles. The total drawbar pull exerted by the locomotive is 16,400 lb. at a speed of 37 miles an hour, and 10,600 lb. at a speed of 62 miles per hour.—Lond. *Electrician*, Oct. 22.

Buffer Batteries and Electric Traction.—A. W. E. HARRIS.—The first part of a paper in which the author deals with the general considerations governing the installation of a battery, and emphasizes the need of designing it as an integral part of the whole scheme. The necessity for using an automatic booster is indicated, and the principal types of booster are then described, diagrams of each being given. The paper is to be concluded.—Lond. *Electrician*, Oct. 22.

Single-Phase Traction.—W. WECHMANN.—The continuation of his illustrated article on electric traction on the Blankenese-Ohlsdorf-Hamburg line of the German railways. In the present instalment the equipment of motor-cars is described. The latest motor-cars of the Allgem. Elek. Ges. have only two motors, just like the Siemens car. Each motor has a guaranteed capacity of 180 hp per hour, but tests have shown a capac-

ity of 200 hp. The motors are artificially cooled. The article is to be continued.—*Elek. Zeit.*, Oct. 21.

Electric Locomotive.—F. Gubler.—An illustrated description of the construction of some electric locomotives which are used on the electric street railways of the city of Brünn, in Austria, for freight transportation. The locomotive has four 42-hp motors.—*Elek. und Masch.* (Vienna), Oct. 17.

Installations, Systems and Appliances.

Electrical Engineering in the United States and Germany.—W. Fellenberg.—The first part of a statistical article on the development of the electrical industries in Germany and in the United States. A comparison is given of the wages paid in both countries. Unskilled labor is paid almost the same wages in Germany as in the United States, while for the higher skilled labor (locksmiths, toolmakers, etc.), the American wages are about twice those in Germany. However, manufacturers in Germany have not only to pay the wages to their workingmen, but also their insurance for old age, accidents and sickness, since such insurance is made obligatory by the Government. The cost of this insurance may be estimated as about 3 per cent of the wages paid. The area of the United States is 13 times that of Germany, but the population is only 50 per cent greater. The track length of railways in the United States is 6.5 times that of Germany. But the track length of trunk railways per unit of area in Germany is 100 times greater than in the United States. The development of street railways has been larger, relatively as well as absolutely, in the United States than in Germany. The track length of street railways in the United States is 14.3 times that of Germany. There are 9.7 km (5.8 miles) of street railways per 1000 sq. km (386 sq. miles) and 48 km (29 miles) of trunk railways in the United States, while the corresponding figures for Germany are 9 km (5.4 miles) of street railways and 100 km (60 miles) of trunk railways. The capital invested in the iron and steel industry in the United States is 130 per cent higher than in Germany. The copper production of the United States is 13 times that of Germany. The capital invested in the electrical industries of the United States is only about 30 per cent higher than in Germany. Fig. 4 gives comparative curves of the development of central stations in the United States (drawn-out line) and in Germany (dotted line). The abscissas are the years and the ordinates the number of central stations. Fig. 5 gives comparative curves for the number of new central stations opened each year in the two countries. The article is to be continued.—*Elek. Zeit.*, Oct. 21.

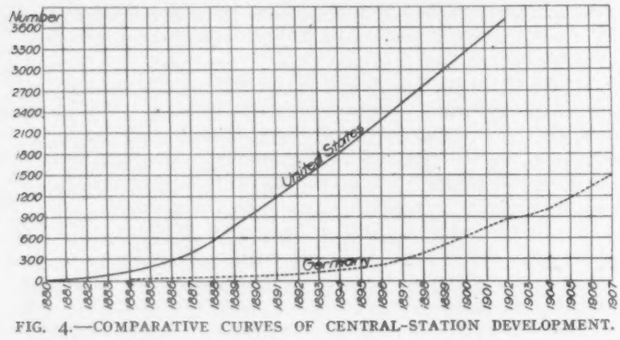


FIG. 4.—COMPARATIVE CURVES OF CENTRAL-STATION DEVELOPMENT.

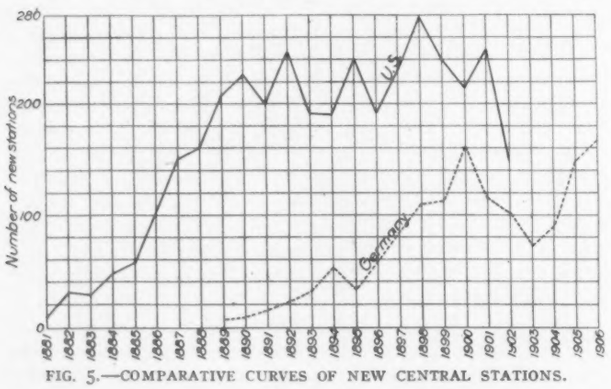


FIG. 5.—COMPARATIVE CURVES OF NEW CENTRAL STATIONS.

British Central Stations.—A statistical table giving data on recent progress of 12 representative central stations in England. Three of these are owned by private companies, the other nine are municipal. Seven are in the provinces and five in London. The growth of many undertakings has been very rapid, Birmingham showing an increase from 4,645,027 kw-hours per year in 1904 to 24,406,227 kw-hours last year. The largest output of any municipal supply undertaking is now Manchester's 66,924,864 kw-hours recorded last year; this is equivalent to over 100 kw-hours per head of population. If account is taken of the smaller outputs and load factors of the electricity supply undertakings at Leeds and Glasgow, the total cost (excluding capital charges) per kw-hour sold in these towns—namely, 1.34 cents and 1.42 cents, respectively—compares not unfavorably with the figure of 1.32 cents per kw-hour at Manchester. The lowest cost recorded, however, is 1.04 cents per kw-hour for the combined lighting and traction supply undertaking at West Ham, while at Bolston a figure as low as 1.16 cents is reached. As to the effect of the capital charges it is pointed out that the station showing the lowest capital expenditure per kilowatt of plant installed also records the lowest average price per kw-hour sold for private supply, namely, 2 cents per kw-hour at West Ham; while the station showing the second lowest capital expenditure, namely, Bolton, also occupies the second place as regards the lowest average price charged per kw-hour.—Lond. *Electrician*, Oct. 22.

Refrigerating Machinery.—F. H. Davies.—Some notes on refrigerating machinery, its installations and uses, and its usefulness as a load for electric central stations.—Lond. *Elec. Review*, Oct. 22.

Interlocking.—T. Toldin and O. C. Dinerman.—An illustrated article on methods of effective interlocking of motor starters and shunt regulators.—Lond. *Elec. Review*, Oct. 15.

Record Charts for Central Stations.—An illustrated note recommending a simple system of filing and storing record charts for central stations.—Lond. *Elec. Review*, Oct. 22.

Electrophysics and Magnetism.

Damping of Electric Oscillations.—C. Richter.—An account of experiments in which the author investigated the damping of electric oscillations, if the sparks are produced in different gases. The author used air, carbonic acid, oxygen, nitrogen, hydrogen and illuminating gas. The damping is greatest in hydrogen and smallest in oxygen. But the difference between oxygen and air is almost insignificant.—*Phys. Zeit.*, Oct. 15.

Electrochemistry and Batteries.

Electrolysis of Hydrochloride Acid.—F. A. Gooch and F. L. Gates.—An account of an investigation of the electrolytic decomposition of hydrochloric acid with special reference to the question of the ions carrying the current and of the speed of transportation of the hydrogen and chlorine ions. The authors criticise a recent investigation of Doumer.—*Amer. Jour. of Science*, November.

Units, Measurements and Instruments.

Gas Tests.—J. B. C. Kershaw.—A description of the gas-testing apparatus designed by the Hamburg Smoke Abatement Society. It is used for the control of boiler and furnace firing like the automatic CO_2 recorder. The apparatus is shown in diagrammatic form in Fig. 6. The sample of gas is drawn constantly (using natural or artificial draught) from the exit flues by means of the pipe *L*, and as it passes over the aspirator *C* a small portion of the gas-flow is sucked down into this by the action of clockwork on the bell *E*. The aspirator above this bell is filled with water covered with a film of paraffin oil, and the rate at which the bell sinks and the gas is sucked into the space *G*, above it, is controlled by a pendulum and simple clockwork arrangement at *U*, the speed of which can be varied to suit the length of the firing shift. At the end of 8 or 12 hours (that is, when the firemen change) the clockwork is stopped and the average sample of gas stored in the space *G*

is tested for carbon dioxide and for oxygen by aid of the Orsat apparatus, shown on the right-hand side of the aspirator, a rubber tube being employed to connect the aspirator and the Orsat apparatus. Two tests of the average sample of gas are made, and the aspirator is then emptied by raising the bell *E* and by opening the taps *a*, *c* and *d*. By closing *a* and opening *b*, and by starting the pendulum of the clock again, the apparatus is set for taking the next average sample—no attention being required for 8 or 12 hours—according to the length of the firing shift. The pipe *L* is kept free from soot and rust deposits by blowing steam or compressed air through it (at

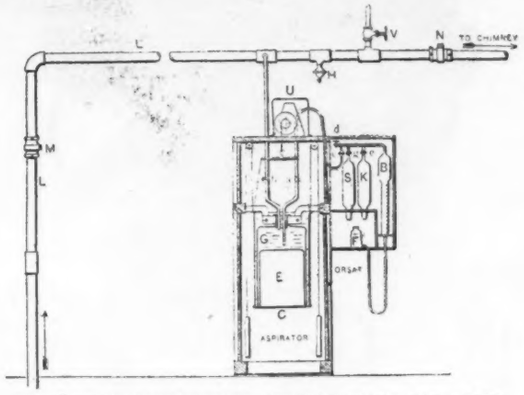


FIG. 6.—ARRANGEMENT OF APPARATUS FOR GAS TESTS.

regular intervals) by means of the tap at *V*; and snap samples of the exit gas can be taken when desired without stopping the aspirator by connecting the cock at *H* with the tap on the Orsat apparatus at *d* by means of a thick rubber tube. The absorbing solutions used in the Orsat apparatus are caustic potash for the CO_2 and an alkaline solution of pyrogallic acid for the oxygen. These solutions require renewal every three or four weeks. It is recommended to grant a bonus to firemen for high percentages of carbon dioxide, and tables are given showing the value of fuel saved and the corresponding bonus recommended. Lond. *Elec. Review*, Oct. 22.

Meter.—A note on a new electric meter designed by Fery, of Paris, and based on the same principle as the Aron pendulum meter. The meter comprises two independent sets of apparatus, which may be installed at a distance from one another. One of them is a system of two equal pendulums, in which the mass consists of a curved solenoid with an iron core. In the center of each core is a polarized block which is exposed to the effect of a fixed coil, opposite the lowest point of the pendulum's travel, through which the current flows. The movable solenoids of both pendulums are polarized by the weak current of a shunt circuit. These pendulums do not come in contact with any fixed parts. A small auxiliary pendulum is used, consisting of a bare copper ring, into which projects the pendulum-solenoid. The oscillation of the auxiliary pendulum is displaced by one-quarter period with respect to that of the main pendulum; when the latter, therefore, reaches its maximum velocity, the auxiliary pendulum is at its minimum. The contacts are made by the auxiliary pendulum. One of them is used for sending a weak current into one of the fixed coils, surrounding the other pole of the solenoid, during one-half oscillation. The other contact sends a current through the second part of the apparatus, the function of which is the addition of the oscillations of the pendulums. The adding device is a rotary-field motor, the stator of which carries four poles. Two of its coils are traversed by the interrupted currents of one pendulum, and the other two coils by those of the other pendulum. When the current impulses of one pendulum arrive before those of the other, the rotor will revolve, say, from left to right. The rotation will change in direction when the second pendulum has come up to and passed the first. The rotor revolves only by the small angle necessary for advancing the integrating clockwork by one tooth by means of a ratchet. The pendulums start automatically as soon as current flows through the apparatus; they require very little energy for maintaining their movement and there is no friction between the moving parts.—Lond. *Electrician*, Oct. 22.

Melting Points.—W. P. WHITE.—An account of an investigation of melting-point determinations. One of the interesting points brought out by the author is that actual melting and freezing-point curves are nearly oblique—that is, they show, not the constant temperature called for by elementary theory, but instead an interval within which the temperature continuously rises or falls. The prime cause of obliquity in melting curves is the obliquity of the melting itself, due to impurity. The true melting point is the high end of the oblique melting interval. Electrical conductivity in the melt produces an error in the reading of bare thermo-elements, thus far negligible in small charges of salts. Contaminated elements, besides reading false, read so as to increase obliquity.—*Amer. Jour. of Science*, November.

Cable-Fault Localization.—E. RAYMOND-BARKER.—Continuations of his long illustrated article on cable-fault localization graphs in practice. The author deals with the polarity of test currents, the effects of "telluric" currents on cable-break localization, and graph proofs of cable-break test conditions.—Lond. *Elec. Review*, Oct. 15 and 22.

Series Transformer.—W. GENKIN.—In accurate electric measurement it is often important to know the error introduced by a series transformer. The use of a wattmeter has certain disadvantages. The author describes a new method which is essentially based on the mathematical theory of the series transformed.—*La Lumière Elec.*, Oct. 16.

High-Tension Oscillograph.—An illustrated description of a Duddell oscillograph for use on a 50,000-volt circuit.—Lond. *Electrician*, Oct. 22.

Telegraphy, Telephony and Signals.

Electric Clocks.—An illustrated description of some new master clocks of special construction to be used for electric time service in connection with the astronomical installation at the observatory in Mauritius.—Lond. *Elec. Review*, Oct. 15.

Miscellaneous.

Corrosion of Copper and Brass.—E. L. RHEAD.—An abstract of a paper read before the (British) Institute of Metals, which is of interest in connection with condenser tubes. Copper and copper-zinc alloys in contact with saline solutions, such as sea water, corrode in a peculiar manner. Brass condenser tubes exhibit deep pits on the side next the water. These often occur in lines. In other situations and under other conditions copper enrichment takes place. The pits in the case of condenser tubes are commonest on the side of the tube lying undermost when the tube is in position. The corrosion is most erratic. It is generally attributed to selective chemical action and to electrolytic effects due to the duplex structure of the alloy. In the experiments mentioned in the paper samples of hard copper and brass were submitted to corrosion in various saline solutions and their behavior noted. Some of the solutions were saturated with carbonic acid gas. The figures obtained showed the greater tendency of the hard material to corrode. The edges and parts of brass plates that were scratched showed deposition of copper. Strips of hard brass were softened at one end and bent into U-shape. When the free ends were put into corroding solutions the hard limb dissolved more extensively and rapidly than the soft limb, the hard metal appearing to form an electric couple with the soft metal. Corrosion occurred in lines parallel with the direction of rolling. The surface of the hard metal was made very rough and irregular. That of the soft metal remained smooth. These roughnesses may form points from which the disengagement of gases dissolved in water flowing through condenser tubes may take place, thus facilitating the pitting and hastening the corrosion and failure of the tube. From this it would appear that the final cold drawing of a tube to produce stiffness is liable to produce irregularities that may increase the rapidity of attack.—*Electrochem. and Met. Industry*, November.

NEW APPARATUS AND APPLIANCES

Commutating-Pole Traction Motors.

Of the many improvements made in direct-current machinery during recent years not the least important is the commutating pole, the most prominent advantage of which is the freedom from sparking. The commutating pole has been widely adopted for constant-speed and adjustable-speed shunt-wound motors, and is now being used with pronounced success on series-wound railway motors. Commutating-pole railway motors are forced to operate without the slightest sign of sparking at any output up to 50 per cent overload. The present description deals with a line of commutating-pole railway motors rated at from 22.5 hp to 145 hp for e.m.fs. up to 900 volts, recently placed on the market by the Siemens Brothers Dynamo Works, Ltd., Caxton House, Westminster, S. W., London, England.

The general features of the design are shown in Figs, 1, 3 and 4. In Fig. 4 it will be seen that there are the usual four main poles, and, in addition, two commutating poles, one between the main poles in the upper half of the motor and the other between the main poles in the lower half. In order to provide as much room as possible for these commutating poles and their windings, the main poles are given a special shape, such that the magnet coils are not symmetrical about the center lines of the poles, but are displaced sideways. The pole faces, however, are spaced symmetrically round the armature, so that there is no interference with the proper distribution of the magnetic flux. The main field coils and the commutation coils are specially wound to such a shape as to fit into one another, so that practically no extra space is required for the additional coils.

Traction motors of the ordinary type, without commutating poles, are naturally sensitive to sparking, and for this reason the early attempts at some degree of control by varying the strength of the field in relation to the armature current were practically abandoned. As soon, however, as there were introduced motors in which there was no fear of sparking, even when 50 per cent of the field current was shunted, the objections urged against this method of control were no longer valid. For use with the motors described above there has been designed a controller in which provision is made for shunting the field windings in varying degrees as may be suitable for any particular case, such for example as 25 per cent and 50 per cent. In this way there is obtained a controller in which, instead of there being as usual only two economical running positions, namely, full series and full parallel, there are at least five, for example: (1) full series, full field; (2) full series, field coils shunted 50 per cent; (3) full parallel, full field; (4) full parallel, field coils shunted

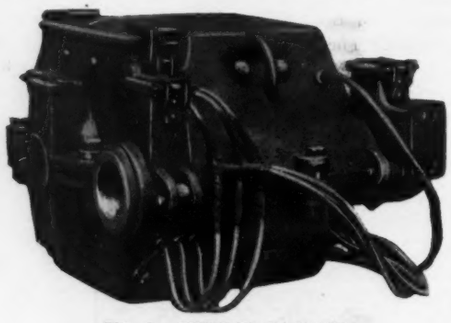


FIG. 1.—EXTERIOR OF MOTOR.

25 per cent; (5) full parallel, field coils shunted 50 per cent. This system of control offers two important advantages, namely: (1) The driver has a more complete control over his car, having the choice of five different speeds under any given

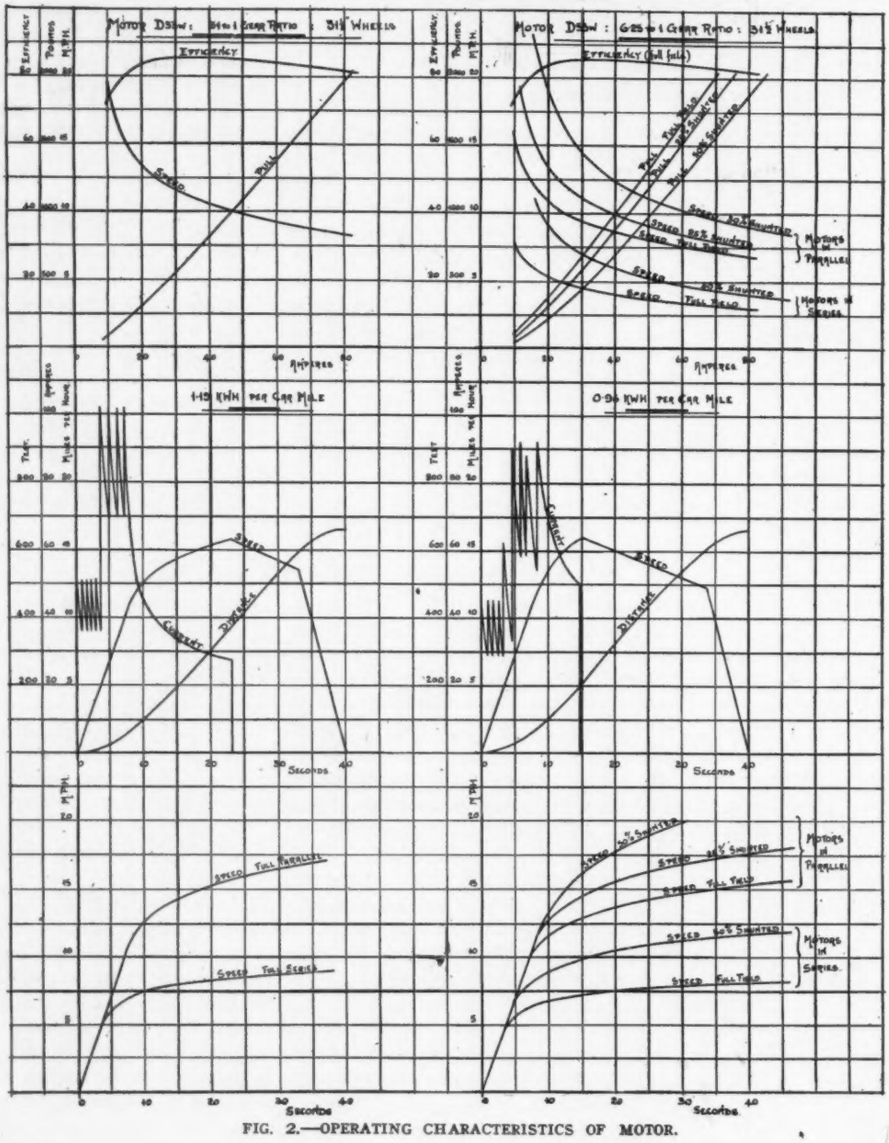


FIG. 2.—OPERATING CHARACTERISTICS OF MOTOR.

conditions; (2) a considerable economy in consumption of energy is made possible.

The curves shown in Fig. 2 will serve for illustrating the advantages just mentioned. These curves relate to a 10-ton tramcar, equipped with two 38-hp commutating-pole motors. Two sets of performance curves for these motors are given, one for the motor geared with a reduction of 97:19 and the other

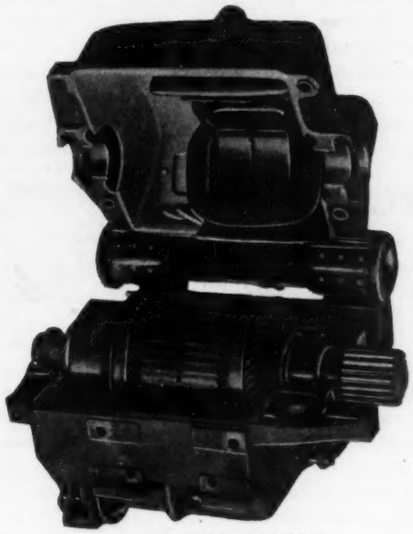


FIG. 3.—INTERIOR OF MOTOR.

with a reduction of 100:16, the diameter of the driving wheels in each case being 31½ in. In the first case, the speed and pull curves are given for the full parallel position of the controller; in the second case, speed and pull curves are given for the five running positions of the controller. With these two sets of curves a sample run has been worked out, as shown in the diagrams, in accordance with the following particulars:

Tractive resistance assumed to be constant at 20 lb. per ton; number of stops per mile, 8; average speed, including 5-second stops, 10 miles per hour; maximum speed, about 16 miles per hour.

The energy consumption has been worked out with the following results:

With field coils not shunted, 1.19 kw-hours per car-mile.

With field coils shunted, 0.96 kw-hour per car-mile.

In the case chosen, therefore, the change of gearing and the different method of control make possible a saving of about 20 per cent in the energy consumption. This may possibly be regarded as an extreme case; but the matter may be put in an-

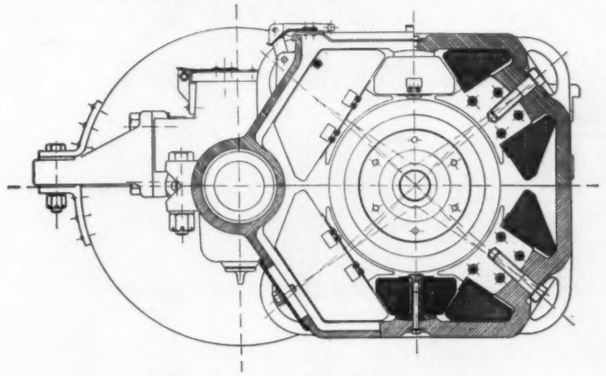


FIG. 4.—CROSS-SECTION OF MOTOR.

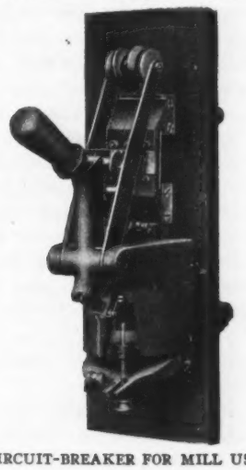
other way. The energy imparted to the car between standstill and the time when it reaches a speed of 12 miles per hour is in the one case 82 watt-hours and in the other case 68 watt-hours, so that, on the assumption that this is repeated at regular intervals of 45 seconds—that is, 80 times per hour—the energy saved per car during that hour is 1.12 kw-hours. Thus, quite apart from the question of the energy absorbed by the brakes, which will vary according to the particular circumstances of the case, there is a clear saving of 10 per cent of the energy consumption in imparting to the car a speed of 12 miles per hour.

The flexibility of the system of control by means of shunting the field coils is clearly seen by reference to the remaining curves. These two curves show speed-time curves for the two cases. In the first case there are only two speed-time curves, namely, that in which the motors are in full series and that in which the motors are in full parallel; in the second case there are five speed curves corresponding to the five running positions of the controller. The comparison between the two sets of curves requires no explanation. The degrees of shunting assumed for the purpose of the above calculations are not necessarily fixed, but may be modified to suit each particular case for which the equipments are desired.

Circuit-Breaker for Mill Use.

Where circuit-breakers are installed in central stations and where they are operated by skilled attendants they give very little trouble, and even comparatively complicated pieces of mechanism will operate year in and year out successfully. Where, however, breakers are mounted in mills where they are subject to the elements, to dust, and to handling by unskilled operators, the case becomes quite different, and the circuit-breaker which is the simplest and has the fewest pivoted parts is the most satisfactory, other things being equal.

Realizing that a mill and a switchboard circuit-breaker are really two different classes of apparatus, the Condit Electrical



CIRCUIT-BREAKER FOR MILL USE.

Manufacturing Company has developed the circuit-breaker illustrated in this article for mill work. The main difference between it and other forms on the market lies in the omission of the toggle or power multiplying device.

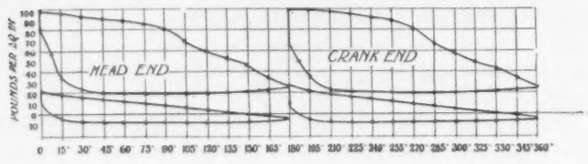
On account of the pressure exerted by the laminated brush, some multiplying device heretofore has been considered necessary, but by the employment of the flexible laminated brush, and by taking advantage in the shape of the handle of the natural toggle of the arm, circuit-breakers up to 2000 amp in capacity are now made without a toggle.

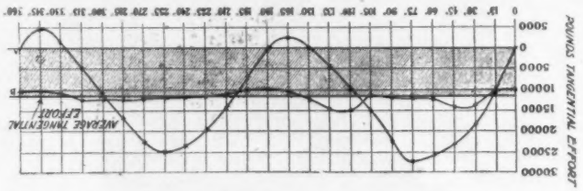
As will be seen from the illustration, the circuit-breaker is graceful in its lines and extremely simple in its construction. The interlocking features, the coil per pole, maximum-contact minimum-resistance carbons, and the general mechanical design of the older Condit circuit-breakers have all been retained in this new type. It is made in all of the forms, including overload, underload, shunt trip, no-voltage and reverse current; and all of these forms are so arranged that the operation of any one pole will open all poles of the circuit-breaker.

The makers claim that the new, simple mechanism which obviates the chance of mechanical difficulties on circuit-breakers, combined with the coil per pole feature, which obviates electrical difficulties, combine to make this circuit-breaker one which will positively operate under all conditions.

Arrangement of Engine Cylinders to Produce Uniform Torque.

One way to produce a more even turning moment of an engine-driven shaft is to connect several cylinders to a single crank shaft. This gives numerous impulses per revolution and each being of the same intensity and occurring at equal intervals of time, produces a practically uniform turning effort and also has the further advantage that for a given amount of work the thrusts given by the separate cylinders can be smaller than if all were delivered by one. While the above point is well known, it will, however, be a surprise to many to know how uniform a turning moment can be produced in a two-cylinder engine having the cylinders correctly located and the load properly divided between them.





FIGS. 1 AND 2.—INDICATOR CARDS AND CRANK-EFFORT DIAGRAMS.

In the angle-type engine, illustrated herewith, the low-pressure cylinder is placed vertically on the same bedplate with the high pressure and exactly 90 deg. to it. In this case it will be seen that the maximum thrust, due to the admission of steam to the low-pressure cylinder does not occur until after the high-pressure cylinder has finished half its stroke, and the pressure in it is rapidly falling off. Then maximum pressure occurs in the low-pressure cylinder and after it has finished half of the stroke, steam is again admitted to the other side of the high-pressure piston, and so on. It will thus be seen that instead of the two maximum thrusts occurring at the same time there are four which follow one another with uniform regularity. This arrangement tends to produce a more uniform turning force, and the following diagrams have been worked out accurately to show how the force actually varies in the two cases.

The four indicator cards in Fig. 1 are from a compound engine and the same cards were used in figuring out both curves in Fig. 2.

The position of the cards, as shown in Fig. 1, represent the events as they occur in a tandem engine. Curve *A* was plotted from the cards in this position. The ordinates for each card were taken for every 15 deg. turned through by the crank and multiplied by the corresponding piston areas. The sum of these two gives actual pounds thrust on the piston. This was then corrected for angularity of piston rod, so that of the total thrust only that portion was plotted which tends to push the pin in a circular path.

It is seen that with the tandem engine, the tangential force delivered to the crankpin at first rises very rapidly, then quickly falls to zero and when the crank has turned through an angle of approximately 150 deg., or is very nearly at the end of one stroke, the force becomes negative. This is due to the fact that the steam pressure resulting from expansion is rapidly becoming lower while the steam on the other side of both pistons is being compressed at the same time; hence, at this point, instead of the pistons tending to drive the pin forward, they become a drag and have to be carried to the end of the stroke by the inertia which is stored up in the flywheel.

Curve *B* shows the crank effort from an American Ball angle compound engine. Here the low-pressure cards are moved forward 90 deg. and the tangential efforts were figured out separately for each cylinder for every 15 deg. and then added together. The remarkable thing about this curve is its extreme "flatness," which shows how small the variation in turning moment is in this engine.

The cards were taken from an American Ball angle-compound engine, in which the piston areas, points of cut-off and division of the load have been carefully worked out with a view of producing this uniform torque. If the effects of inertia had been taken into consideration, the results would have shown up still more favorably to the angle-compound engine, as the masses moving in the same direction are smaller and the fact that they are separated 90 deg. allows of perfect balancing, which is impossible with either the tandem or cross-compound construction.

The line of average tangential effort was located in the force diagram by means of a planimeter, and was found to be the same for both engines, showing that the total amount of energy delivered by both is the same. This line is at the top of the shaded area and represents the continuous pressure necessary to carry a given load; when this necessary crankpin pressure is exceeded in one part of a revolution there must be a corresponding deficiency in another part. From curve *A* it is seen that the turning pressure on the crankpin of a tandem engine rises very greatly above the average amount twice in every revolution and falls not only to zero, but becomes negative due to the compression at the end of the stroke. The only practical way to try and smooth out the turning moment delivered by one of these engines is to use a heavy flywheel, which takes the excess energy represented by the area of one

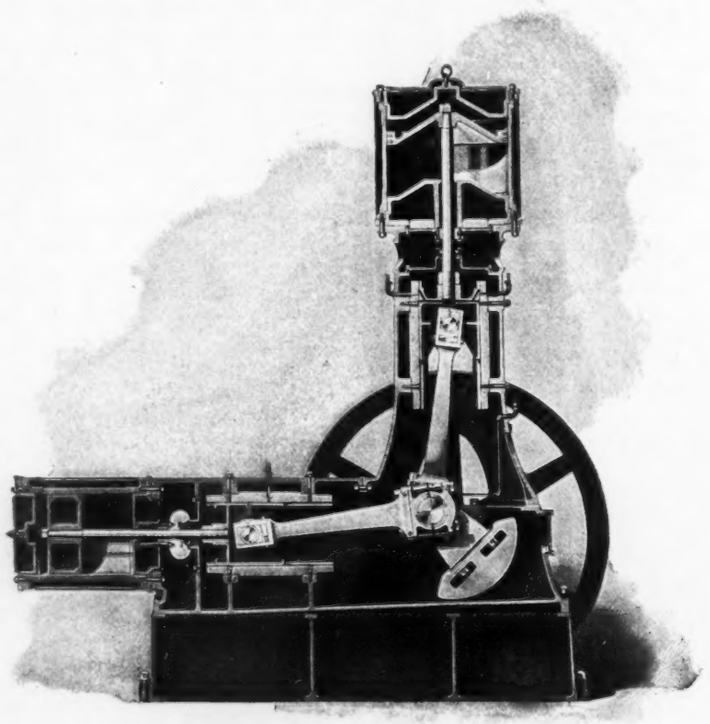


FIG. 3.—CROSS-SECTION OF ANGLE-COMPOUND ENGINE.

peak of the curve above the line of average pressure and carries it over to fill in the deficiency represented by the "valley" in the next portion of the curve. Of course, the larger the variation, the larger the flywheel will have to be, and where heavy flywheels are used, the wear on bearings is faster and more oil for lubrication is necessary.

Uniform turning moment is very important where alternators are to be run in parallel, as the variation in angular velocity, such as occurs in either simple or tandem-compound engines, sets up cross-currents, which cause heating of the generator armatures and interferes with the regulation.

The American Engine Company has realized the special adaptability of this type of engine for small high-speed units and has perfected designs and is now building units of from 100 hp to 500 hp to run at speeds of 250 r.p.m. to 325 r.p.m., and for condensing or non-condensing service. These engines are suitable for any class of service, but are especially adapted for isolated-plant work, such as carrying hotel, apartment-house and office lighting loads. For this purpose their freedom from vibration especially recommends them. An ordinary lead pencil, it is stated, will stand balanced upright on one of these engines when it is running at 325 r.p.m.

It has been suggested that small turbines might be used for isolated-plant work, and in this connection the makers of the present engine point out that small turbines are not economical, especially when running non-condensing, as they consume 50 lb. to 70 lb. of steam per hp-hour when exhausting to the atmosphere, whereas one of the angle-compound engines, if supplied with steam at the same pressure, will, it is stated, furnish a hp-hour on 25 lb. A small-sized turbine to be run as economically as this would have to exhaust to a high vacuum. This introduces the extra complication and expense of condensers and air pumps and leaves no exhaust steam available for heating, which is generally considered as desirable in isolated plants.

Automatic Typewriter Telegraph.

Messrs. George C. Cummings and John A. Kick, of Chicago, have invented an automatic telegraph system which, it is claimed, will do away entirely with the services of expert telegraphers in sending and receiving telegraph messages. A single-keyboard typewriter of any standard make can be attached to one wire by means of this invention and the telegraphing is done automatically by simply operating the keys of the typewriter by any person who can manipulate the typewriter keyboard.

At the receiving end the message is received on another typewriter, and is printed in the ordinary characters of the typewriter on telegraph blanks supplied preferably from a continuous roll of paper. At the receiving end all that the attendant has to do is to cut one or more of the messages from the roll as they are typewritten.

The inventors of this system are practical telegraph men. Mr. Cummings is circuit manager in the telegraph department of the Chicago, Burlington & Quincy Railroad, and Mr. Kick has just resigned his position as inspector of telegraphs for the same railroad to further the interest of a company formed to exploit this and other inventions. This company is the Charter Electric Company, recently incorporated under the laws of Illinois, with $100,000 7 per cent preferred stock and $150,000 common stock. The company has its office at 184 Dearborn Street, Chicago. Mr. Cummings is president, Mr. Archibald Wray is vice-president, and Mr. Kick is secretary and treasurer. These gentlemen, with Mr. J. G. Wray, of Chicago, and Mr. T. M. Haston, of Galesburg, Ill., constitute the board of directors. The company also owns other electrical inventions, but will devote most of its attention, perhaps, to the automatic telegraph system.

It is asserted that the typewriter telegraph can be operated at a speed of from 60 to 75 words a minute—that is, the apparatus is capable of all the speed which the typist can use in operating the typewriting machine. It increases the working capacity of the line wire and does away with the necessity of employing telegraphers, as stated. While the sending operator is writing out the message on her machine, the message is being automatically transmitted and is being received on the typewriter at the receiving end. Another feature of the machine, according to the inventors, is that it can be duplexed; that is, it may be worked both ways simultaneously. But one wire is needed.

Some patents of this system have been allowed and others are pending, so that the inventors do not care to make any detailed description public at the present time. However, it may be stated that alternating currents are used, and by means of various combinations of frequency the selective apparatus picks out the character at the receiving end corresponding to that on the key struck by the operator of the typewriter at the sending end. Sixty combinations can thus be made. The sending instrument is so constructed that it is in electrical step with the receiving end.

The characters are transmitted by selecting one of the 60 combinations. By varying the operating voltage, say, from 75 volts to 290 volts, and by the use of a common relay, the electrical impulses select at the receiving end the character corresponding to that desired by the sending operator.

It is said that if the machines get out of step the only trouble that will result will be the transmission of one wrong character, for the line is "cleared" after the transmission of each character in the message. The apparatus has been tried on the telegraph circuits of the Chicago, Burlington & Quincy Railroad, and it is believed that it will work on a line 500 miles long without a relay. Automatic repeaters can be used as in ordinary telegraphy. The same electrical energy is required as with the polar duplex.

The instrument is not in commercial service as yet, but the fact that reputable telegraph men of long practical experience say that the apparatus has worked satisfactorily on trial makes the announcement of the appearance of this automatic typewriter-telegraph system of much interest. Of course, if the inventors are not oversanguine, the advent of this system may work a revolution in telegraph service where there is sufficient business to warrant the expense of introducing the apparatus. It is said that the price of a set of instruments, consisting of the sending instruments and the receiving instruments, will be about $5,000.

The other patents controlled by this company are also of considerable ingenuity and interest. One device by Messrs. Cummings and Kick relates to an electric typewriter which can be arranged without the telegraphic selective apparatus, so that two typewriters can be installed in different departments of a commercial house—say, between the order-room and the shipping department—and the operation of one machine will simultaneously operate the other in the distant room.

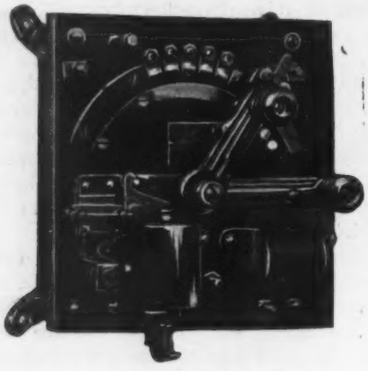
The Cummings-Wray train-dispatching system, which has been in use for some time, is also owned by this company. This system is used in connection with train dispatching by telephone.

By its use the dispatcher at the main office can, by pressing a row of buttons on the instrument, cause a 4-in. gong to ring on all of the stations of the line represented by the buttons pressed. If he presses buttons 1, 2, 3 and 4, for instance, the gong at the distant station 1 will begin to ring, and 1½ seconds later the gong at distant station 2 will begin to ring, and so. These gongs will continue to ring until the telephone train operators at the distant stations answer the call. By this means a great saving of time on the part of the train dispatcher is effected where he wants to communicate with several distant station operators at nearly the same time, as is often the case.

Another invention owned by the company is the Cummings "booster telephone," by which it is said to be possible to connect 25 or 30 telephone stations on one line, extending the party-line idea much farther than anything known at present for efficient service.

Field-Control Motor Starters.

The cut shows a Ward Leonard motor starter with no-voltage release and overload circuit-breaker equipped with steps of resistance for speed control by field regulation. This rheostat is equipped with 16 steps of field resistance designed to give 2 to 1, 3 to 1 or 4 to 1 speed control, as may be specified, and with but five steps of field resistance to give approximately 30



FIELD-CONTROL MOTOR STARTER.

per cent field control. The rheostat is so arranged that the motor will not be started under conditions of weakened field. The resistance is entirely enclosed. The field resistance consists of standard Ward Leonard enameled resistance units. The resistance in the armature for starting is a low-temperature coefficient wire or strip.

The Dynatak.

A novel instrument, the invention of Prof. N. Monroe Hopkins, of the George Washington University, Washington, D. C., has recently been put upon the market under the trade name of "Dynatak." The instrument is a combination power indicator and precision speedometer without a flexible shaft, and when the equipment is installed upon a stationary engine, automobile, motor boat or aeroplane indicates as follows:

First, what the cylinders of the engine are doing separately or together; second, which, if any, cylinder is missing fire; third, the power of the engine, and the conditions under which it is doing the most useful work; fourth, how to adjust the carburetor perfectly when the engine is idle as well as under load; fifth, speed with absolute precision from 1 mile to 60 miles or 100 miles per hour and mileage; sixth, revolutions per minute of the propeller in aeroplane and marine work.

The instrument is an original application of the fact that an electric current is produced by the simple heating of the junction of two dissimilar metals, and the magnitude of the current so generated is proportional to the junction temperature.

Ordinary thermo-couples as evolved by Becquerel and used for general temperature measurement in the arts and sciences would never "live" or operate under the high temperature and peculiar chemical conditions in a gasoline-engine cylinder, because they would become so heated as to pre-ignite the charge and cause the gas engine to buck, hitch or back-fire, and in addition would become brittle and drop apart either through oxidation or the absorption of carbon after a short period of use. Actual temperature measurements by means of thermo-couples or thermometers could not be made in gasoline-engine cylinders.

As a result of years of experimentation, Professor Hopkins, the inventor, has developed a type of thermo-couple of special design and original construction which gives an index of the temperature in a gasoline engine without actually attempting to measure it. The instrument continuously shows by modified temperature readings the working conditions of gasoline-engine cylinders. It is stated that the Hopkins "thermo-plugs" give the same "electrical pressures" after 50,000 miles' use on an automobile as when first applied.

The "Dynatak" equipment has these specially constructed thermo-couples in each spark plug. They may be selectively or collectively connected with an electrical indicating instrument which gives an accurate reading of the current delivered by one

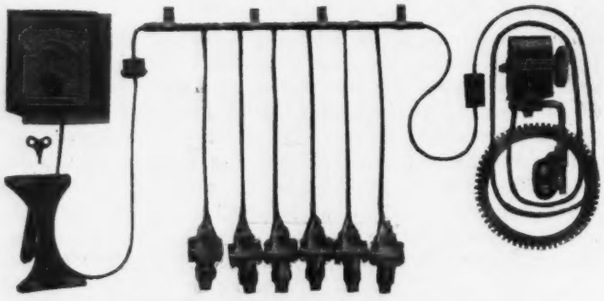
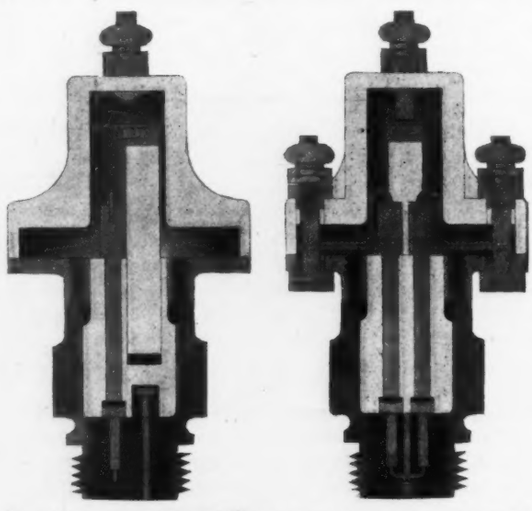


FIG. 1.—THERMO-ELECTRIC COUPLES AND INDICATING APPARATUS.

particular cylinder or by the combined cylinders if the spark plugs be connected in series.

There is a switch on the instrument for obtaining separate or combined cylinder indications. The instrument has two scales, the upper a speed scale and the lower a power scale. On the switch there is also a speed contact S which connects a small magneto-dynamo with the indicating instrument, and electrical current is furnished in direct proportion to the speed at which the dynamo is driven.

In addition to this combination speedometer and dynamometer, Dr. Hopkins has also invented an electric speedometer indicator and tachometer of great sensitiveness and accuracy.



FIGS. 2 AND 3.—SECTION VIEWS OF THERMO-ELECTRIC COUPLE AND SPARK PLUG.

This instrument is mounted in a circular brass case of the finest construction.

The instruments are handsomely made, the index being pivoted in sapphire bearings and the little dynamo having platinum commutator and gold brushes.

The "Dynatak" is manufactured by the Electric Speedometer & Dynamometer Manufacturing Company, of which Prof. N. Monroe Hopkins, the inventor, is president.

Individual Motor Drive in a New Structural Steel Plant.

The Lackawanna Bridge Company, of Buffalo, located near the Lackawanna steel plant, expects to begin operations in the first of its six buildings before the first of the year. This building, which is almost completed, is about 700 ft. long by 300 ft. wide. The electric motor and lighting equipment will

be installed in accordance with the latest methods. Individual 220-volt direct-current motors with remote control will be used throughout for the shop cranes, yard cranes, reamers, gantrys, riveters, and all the machines necessary in structural steel plants. The pilot wires on the remote control switches are to be operated by one wire running from one side of the switch to the switchboard in the power house, and the other side of the switches will be connected to the other side of the line at locations nearest the switches. The main switchboard will be located in the power house, where the 220-volt direct current will be generated. The 54 motors which will be installed, ranging from 1½ hp to 85 hp, total up to about 800 hp. The majority of these are between 5 hp and 30 hp, only four being above 50 hp. The lighting will be principally by 110-volt arc lamps (two in series on 200-volt circuit) or by 220-volt enclosed arc lamps.

Transformers for Making Steel.

Steel making by means of the electric furnace, although at present in a pioneer stage, promises soon to be accepted as the best and cheapest method of manufacturing steel of certain grades. Numerous forms of electric furnaces for this work have been developed, all of these having in common the application of large currents at low voltage. It is evident that alternating current is the best for such work, on account of the fact that the heavy currents necessary may be taken from suitable transformers located close to the furnace. The illustration shows a transformer manufactured by the Pittsburgh Transformer Company which was especially designed for the purpose of operating electric furnaces for steel making. Two of the largest equipments of these Pittsburgh transformers are now in operation, one of these supplied through the Central Electric Company, Chicago, being in service at the South Chicago Works of the Illinois Steel Company, and the other at the American Steel & Wire Company's plant in Worcester, Mass.

These transformers are oil-insulated, water-cooled, and are of core-type design. It is stated that these are among the largest, if not actually the largest, core-type transformers in successful operation in this country at the present time, especially in view of their liberal capacity for overloads. In the design and construction, it was necessary to keep prominently in mind the fact that steel furnace work is of an exceptionally trying nature, with loads fluctuating rapidly from zero up to momentary overloads of several times the rated capacity of the transformers. The mechanical arrangement of these transformers is such that all parts of the windings are rigidly braced and held against any movement which might be caused by sudden current rushes.

On account of the large currents used in these electric furnaces, approximately 30,000 amp, very careful provision was made in the arrangement of the secondary coils and current-carrying cables to avoid serious induction trouble. The illustration of the low-tension terminal board shows the construction employed to feed from the transformer secondary into the copper busbars leading to the furnace. Except for certain special features mentioned, these transformers follow closely the standard practice of the Pittsburgh Transformer Company. Boiler-iron tanks of oval section are used, which are held between cast-iron tops and bases. The water-cooling coils are of heavy seamless copper tubing. The steel used in the cores was the latest formula silicon-alloy, which enabled high electrical efficiency to be secured.

The illustration showing the low-tension terminals for connection to the furnace busbars indicate the massiveness of the current-carrying parts, and a still better idea of this will be gained when it is understood that these low-tension terminals contain 800 lb. of copper.

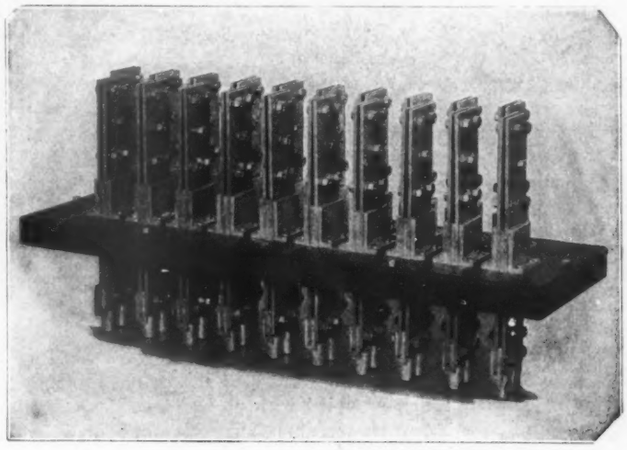


FIG. 2.—LOW-TENSION TERMINAL BOARD.

FIG. 1.—TRANSFORMER FOR STEEL MAKING.

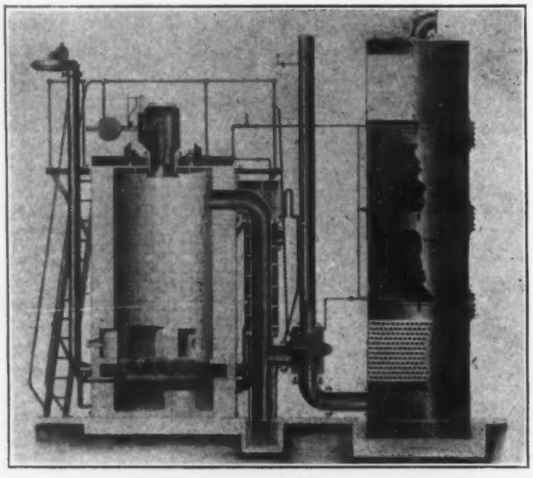
The transformer differs from the standard core type of the Pittsburgh Transformer Company only to the extent in which it becomes necessary to meet the special conditions of the electric steel furnace.

Anthracite Gas Producer.

The producer-gas plant illustrated herewith consists principally of a "generator" in which gas is made, an "economizer" in which the waste heat of the gas is utilized, a "wet scrubber" in which the gas is cooled and practically cleaned, and a "dry scrubber" in which the gas is dried and where it is thoroughly cleaned from dust and moisture.

The generator is made of a steel shell, cylindrical in form and lined with firebrick, and provided with a water-cooled top. At the top is a hopper of the self-locking type, so arranged that it is impossible to dump while the top is open. The grate is of the shaking type operated by a lever arm on the outside of the generator shell.

In passing from the generator to the scrubber, the gas is led through the economizer, the top of which is a water compartment provided with a subdividing wall extending to within 2 in. of the bottom. The cooling water from the top of the generator is admitted into one side of the economizer head, the inner chamber of which is provided with two pipes connecting to the economizer proper. The center of the economizer consists of an iron casting provided with projections in the form of a spiral. The hot water trickling down this spiral is flashed into steam. The bottom of the economizer is connected to the tuyeres in the generators so that the suction on the producer forms a partial vacuum in the closed compartment of the



PRODUCER GAS PLANT.

economizer head, thereby raising the water level in direct proportion to the load, and varying the suction directly therewith. Air is admitted into the outer shell of the economizer through a door provided with an adjustable weight, and is mixed with the steam and drawn into the tuyeres by the suction on the generator.

In the wet scrubber the temperature of the gas is lowered to within a few degrees of that of the cooling water. In the dry scrubber, where the dust and moisture is removed, there are two baffle plates between which is a filling of excelsior, the top of which is soaked in oil. The gas passes through this scrubber at a velocity of not over 20 ft. per second.

It is claimed that at 100 per cent load a brake hp-hour can be produced by 1.058 lb. of coal containing 13,000 thermal units per pound; at one-fourth load, 2.607 lb. is required. The above-described plant is manufactured by the Hill-Hupfel Engineering Company, 30 Church Street, New York.

Dial Decade Testing Set.

A testing set with several devices for facilitating quick and accurate measurements is being put on the market by the Leeds & Northrup Company, Philadelphia, Pa. It is designed for a full range of measurements, which include resistance measurement from 0.01 ohm to 10,000,000 ohms, and fault location by the Murray and the Varley loop tests. This set is designed particularly for the class of measurements which are necessary in maintaining telephone and telegraph lines, and in clearing trouble in them. It is said that the new model has many features which are decided improvements over older types. The preliminary models were submitted to several well-known telephone and telegraph engineers for test, and valuable suggestions made by them were embodied.

The case has been made shallow—only 5 in. deep—so that it can be carried easily, in contrast to those that are almost square. The battery is fastened by two screws to the rubber plate and controlled by a knife switch. This arrangement makes it very easy to lift out the rubber plate complete, with battery, galvanometer and coils all in plain view and easily accessible. In this connection, it might be said that the galvanometer is completely protected and made dustproof by a strong metal case, so that no dirt can enter when the set is opened.

The dial switches can be rotated continuously, and no backward motion is necessary in going from the "9" point to the "0" point. The laminated brushes used in these switches are not bent square at the contacts, but at a slight angle, thus making a brush contact that, instead of wearing a groove in the studs, will simply tend to clean the whole surface. The set is built on the four-coil decade plan. There is, therefore, no crowding of parts and the coils may be easily replaced by the operator if one should be burned out. Metal spools are used throughout, the conductors having a carrying capacity of four times that of conductors on the usual wooden spool. The conductors are of manganin wire wound on brass spools, silk insulated and thoroughly baked in shellac.

The galvanometer in this set is of the suspension type, the

DIAL DECADE TESTING SET.

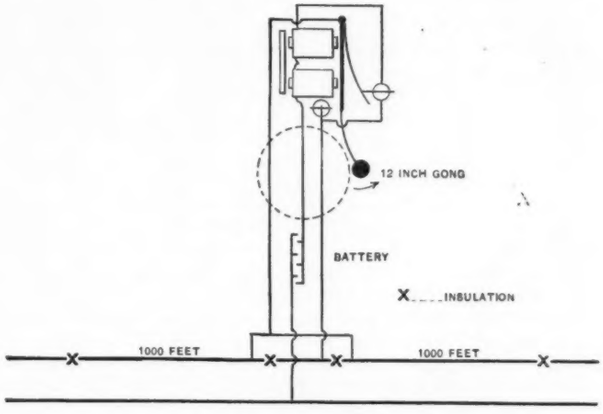
old-style pivot-and-jewel instrument having been entirely discarded on account of its susceptibility to jars which blunt the pivots and make the pointer stick. In the suspension type there is no such trouble. The instrument will actually withstand more rough usage than an ordinary portable voltmeter on account of the spring suspensions; moreover, the galvanometer will deflect for the most minute current that can be put through it, there being no initial friction to overcome. Its sensibility is ample for all ordinary work.

The arrangement of ratio coils is a new feature. These coils are controlled by a single rotary switch that makes contact on ratio studs as follows: 0.01, 0.1, 1, 10, 100 and 1000. The rheostat reading is then simply multiplied by the value indicated by the dial switch, and one is never in doubt as to whether to multiply by arm "A" or arm "B." This arrangement gives a range of from 0.01 times the rheostat reading to 1000 times, this being as large as can be accurately used with any set of this type. The contact resistance, which is so minute as to be negligible and will remain so, is in only the battery circuit, so that even should it be high, it would not affect the galvanometer sensibility.

An improvement in this set is the absence of all flexible cords. All connections for the loop tests, for outside battery and for outside galvanometer are made simply by means of knife switches located on the rubber plate of the instrument.

Railway-Crossing Alarm.

A device is being exploited by Alexander & Keim, of Denver, in the form of a railway-crossing alarm. The alarm consists of a bell actuated by magnet of which the circuit is closed by the car axle from one rail to the other. The distinctive feature is the fact that upon reaching the crossing itself, and during any time spent on the crossing, the ringing of the bell ceases and does not start again until the train has passed out of the block. A train coming in the opposite direction on a single track rings an alarm as it approaches the crossing and the bell will again be silent while the train is at the crossing or leaving it. The annoyance of a bell ringing where stops are made is thus done away with. The diagram of connections is shown in the accompanying sketch. The alarm is actuated by an ordinary dry battery or gravity battery. The circuit through



RAILWAY-CROSSING ALARM.

the middle section of track is direct through coils, not passing through a vibrating contact, the armature being thus held down.

Electrically Heated Oil Tempering Bath.

It has been common practice to heat by gas the oil tempering bath used by manufacturers for the purpose of tempering steel tools or dies, but as very close regulation of temperature is essential for a uniform quality of product, gas heating has not proved satisfactory. Added to this is the ever-present fire hazard when gas is used. As is often the case, the use of electricity has been advocated as a solution of the problem of proper oil tempering, and the General Electric Company has recently perfected an electrically heated oil bath which seems to meet all the requirements of such apparatus. The general appearance of this device is shown in the illustration herewith.

The bath proper consists of a cast-iron tank or pot having 12 lugs evenly spaced around the sides. These lugs are drilled to receive standard cartridge units, and it is found by thus distributing the units that an even temperature can be maintained in all parts of the oil. Around the pot is placed a heat-retaining jacket consisting of an inner and outer wall of sheet metal, the space of 3 in. between the walls being filled with mineral wool. The jacketing on each side of the pot is easily removable, thus allowing quick access to the internal connections of the units. Around the top of the pot there is a wide flange to which are secured four cast-iron legs. A drain pipe controlled by a globe valve provides a means for drawing off the oil. There is a protected recess in one end of the pot in which a thermometer can be placed to indicate the temperature of the oil.

There are two methods of using the oil bath. In the first method, the temperature of the oil is raised to about 250 deg. Fahr., the work is placed in the bath and full heat turned on. When the oil reaches the desired temperature, the work is removed and the current turned off. This method requires a single heat bath. The second method is to turn on full heat, bring the oil to the desired temperature, then introduce the

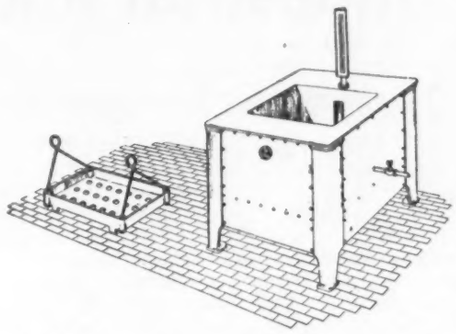


FIG. 1.—ELECTRICALLY HEATED OIL-TEMPERING BATH SHOWING REMOVABLE TRAY.

work, and by means of regulating switches maintain that temperature constant any length of time desired.

Where desired, a cast-iron basket or tray is supplied in which the work can be placed. The basket has eye bolts at each end to facilitate handling. The bottom of the basket is perforated with ⅞-in. holes, permitting free circulation of the oil. There are also legs on the bottom of the basket which keep the work an inch or more above the bottom of the bath.

The heating units are connected in groups according to the size of the bath, and the leads are brought out to the thermal block. In the single-heat device, each group is protected by a fuse. In the multiple-heat device, the leads are carried to the switchboard, the latter being so arranged that the energy input can be varied in small steps from zero to a maximum. A switchboard is not necessary for the single-heat bath, but is required where a multiple heat device is wanted.

Any desired temperature is obtained by throwing in the necessary number of units to give the approximate value. Close regulation is then secured by varying the voltage impressed on one of the units. This is accomplished by means of the rheostat mounted on the board. As a result of this method there is a negligible loss of energy in the regulating device.

The oil capacity and energy consumption of the three sizes in which the bath is made are respectively as follows: 9 gal. and

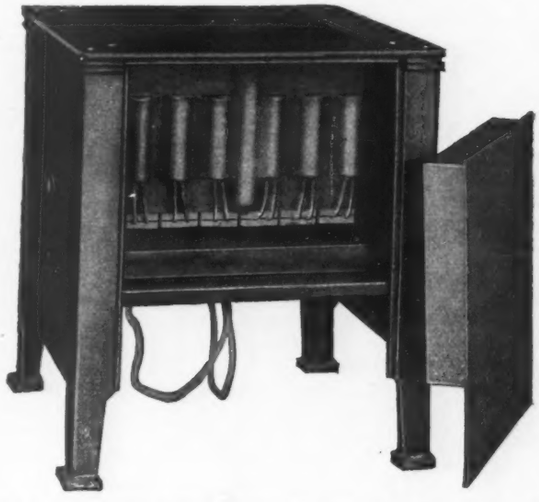


FIG. 2.—ELECTRICALLY HEATED OIL-TEMPERING BATH, SIDE REMOVED, SHOWING RENEWABLE CARTRIDGE UNITS.

6 kw., 11 gal. and 7.2 kw and 37 gal. and 20 kw. The energy consumption is sufficient to heat the oil to a temperature of 450 deg. Fahr. in less than one hour, starting cold.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The condition of trade during the past week continued to be all that could be hoped for. There is a steady development in every industrial line, and wholesalers and jobbers report excellent business. Especially in drygoods, millinery, shoes and clothing there has been active buying. The retailers throughout the country, who for the larger part of the past year have been very conservative, are generally short of stocks, and this means that they are ready to buy at the present time more liberally than is usual at this period. The orders now coming in might properly be referred to as filling-in orders, but they are really purchases made to meet the holiday trade by people who had not sufficiently provided themselves with stocks. Prices continue to be unusually high in all commodities. The only cloud on the present industrial situation is the fact that the cotton mills, both in the North and South, have been compelled to curtail their output. This is due to the fact that the price of cotton goods has not kept up with the advance in raw cotton. It is not believed that this curtailment will be of very long duration, because the country in general is in a buying mood. In the iron and steel industry it is the same old story; the mills are full of orders, and are now taking business that will run well on to the middle of next year in delivery. Collections are so much improved that there is no longer any complaint heard in this direction. The early movement of crops and the increase in retail trade have enabled the Western merchants to meet all of their bills promptly. There are not a great many important business troubles, and the failures that are occurring are usually those of small concerns. For the week which ended Nov. 4 the failures reported by *Bradstreet's* were 212, as against 217 the previous week; 205 the same week of last year; 226 in 1907; 146 in 1906, and 166 in 1905.

THE COPPER MARKET.

After a week of considerable activity and strengthening of prices, the copper market on Nov. 8 suddenly became considerably excited over the large buying orders that were received from Europe. Merton & Company, of London, who a few days previous had contracted with the United Metals Selling Company for 10,000 tons at £59, came into the market again on the date mentioned ready to buy all the standard copper available, regardless of quantity or price. It is said that the transactions for the day amounted to more than for any day of the year, and some estimates placed the amount taken for shipment within the next three months at 50,000,000 lb. In the meantime there is no change in the adverse aspect of copper statistics. The figures for October indicate that domestic consumers took about 50,000,000 lb., and that exports were about 60,000,000 lb. This, it is estimated, is at least 20,000,000 lb. above the actual melting, indicating an accumulation in consumers' hands in the two countries of that amount. The estimated figures of production for the month are 122,000,000 lb., so that in spite of the liberal takings for the month above actual demand there appears to be an increase in the surplus in producers' hands of about 12,000,000 lb. There continue to be all sorts of rumors regarding a trade agreement among the great copper producers, and this may be responsible for the foreign buying. Few of the well posted copper men in this market now believe that a merger into one giant company is probable, but it is generally expected that a price agreement will be reached that will steady the copper market, like the price agreements that control the iron and steel markets. The exports for the month, including Nov. 8, have been 2,200 tons. The daily call on the Metal Exchange quoted Standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	12.60	13.00	....
November	12.65	13.00	12.82½
December	12.75	13.05	12.90
January	12.80	13.15	12.97½
February	12.90	13.00	12.95
March	13.00	13.12½	13.07½

The London prices for Nov. 8 were as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	58	2	6	58	12	6
Standard copper, futures	59	7	6	59	17	6
Market	Strong			Firm		
Sales of spot				800 tons		
Sales of futures				2,200 tons		

Extreme fluctuations for this year:

	Highest.			Lowest.		
		13.00			12.12½	
Standard						
London, spot	£64	2	6	£54	12	6
London, futures	64	17	6	55	10	0
London, best selected	67	15	0	59	0	0

INSULATED WIRE PRICES.—The demoralization in prices of rubber-covered wire, which was referred to last week, is explained by an authority in the trade as being due to the fact that crude rubber has recently been not only very high, but very uncertain in price. "The demoralization in the prices of our goods," he says, "is due entirely to the price of rubber. Regularly organized manufacturers of rubber-covered wire have had difficulty in competing with various other manufacturers who pretend to be offering the same goods. The difference has been in the quality of the rubber-covered insulation. While the well-known makers are putting out the same rubber insulation to-day that they did a number of years ago, there has been, however, introduced into the trade a lot of manufacturers who claim to have the same product, but who are putting out a rubber-covered wire, the covering of which is made up of cheap compositions. Within the last year the price of rubber has been so erratic that rubber has become the most important ingredient. This is the reason that there have been cuts in prices and many prices quoted. In manufacturing this product there is no chance to change the quality of the copper, but there is every chance to change the quality of insulation; so when the insulation has become the chief factor of value, it is very easy to see how prices can be cut to almost any figure."

SUBWAY FOR CINCINNATI.—Comprehensive plans have been presented to the City Council of Cincinnati providing for a subway system to connect the business section with the outlaying residential districts. The plans were drawn by City Engineer Sundmaker, and have the approval of the city administration. They involve an expenditure of from $10,000,000 to $15,000,000. The project is entirely one of municipal ownership, although it is proposed that the roads shall be operated under lease. There is practically no doubt that the Council will pass the necessary ordinances, and it is expected that the work of construction will begin next spring.

SOUTHERN COLORADO POWER COMPANY.—The Southern Colorado Power Company, of which Frank P. Read, Denver, is general manager, is steadily proceeding with the development of its system. Considerable work is now under way, and immediate plans for the future include the addition of several steam turbines; the construction of complete fireproof vaults for transformers and for high-tension switching apparatus, and a complete unit arrangement for the various turbines, and the extension of a number of outside lines to feed mining districts now operating with steam plants.

SIEMENS BROTHERS IN CANADA.—The Siemens Bros. Dynamo Works, of London and Stafford, have opened a Canadian office in Toronto, in the Birbeck Building, in charge of A. S. Herbert. Electrical equipment of all descriptions will be imported from the English works of Messrs. Siemens Bros. companies, and branch offices will be established at Montreal and Winnipeg.

RENO (NEV.) POWER, LIGHT & WATER COMPANY.—Work will soon begin on the dam of the Reno (Nev.) Power, Light & Water Company on the Truckee River. This dam will cost about $1,000,000 and will provide a hydroelectric power station that will furnish energy for many of the mining camps in that section. The Reno Company will also probably erect a plant in the neighborhood of Ely.

TELEPHONE TRAIN DISPATCHING ON NICKEL PLATE.—The New York, Chicago & St. Louis Railroad Company—"Nickel Plate"—is planning a telephone train dispatching equipment for its line from Conneaut to Bellevue. This circuit will be the first one installed by the company, and if it proves satisfactory the company may equip its entire line with telephone train dispatching apparatus. The total length of the experimental line is 132 miles, and there will be 28 regular station equipments, with a number of special siding telephones so located that the train crews can get in direct communication with the dispatcher. The equipment used will consist of the standard Western Electric telephone train dispatching apparatus and Gill selectors. The siding telephones will be mounted in telephone booths which will offer shelter for the train crews when reporting to the dispatcher, or receiving orders from him. Arrangements are made so that the telephone sets at these sidings are automatically cut free from the line when the telephone sets are not in use.

NEW PLANT ON THE FRENCH BROAD RIVER.—The North Carolina Electric Power Company, subsidiary to the W. T. Weaver Power Company, it is announced, will shortly begin the construction of a mammoth power plant across the French Broad River near Marshall, N. C., west of Asheville. The plant will develop 4600 hp, the dam being 30 ft. high and 500 ft. in length, with 18,000 yd. of concrete work in the construction. There will be two 2200-hp generators, the completed plant representing an expenditure of about $400,000. This is the plant from which, it was stated, power for the new electric line from Asheville to Galax, and tapping the new Carolina, Clinchfield & Ohio Railroad, will be derived. Another site a few miles up the river offers further power if such shall be found to be required in carrying out the company's plans. The electric road will be known as the Asheville & East Tennessee, with Galax as the terminus.

IMPROVEMENTS IN HELENA, ARK.—The Helena (Ark.) Gas Company is contemplating the rebuilding of its plant (which includes electric light and power service) at an expense of about $200,000. A new electric power station and new gas works will be built on a new site, concentrating the generating activities of the company, heretofore scattered in separate plants. The property is owned by local bankers, who are negotiating with Chicago and Grand Rapids (Mich.) capitalists to secure funds to finance the rehabilitation. An examination of the situation by engineers and accountants is now under way. If favorable reports are received, the project will undoubtedly be carried out. Mr. E. C. Horner is president of the Helena Gas Company.

CONNECTICUT RIVER TRANSMISSION COMPANY.—The Gas Commissioners of Massachusetts have approved of the action of the Mayor and Board of Aldermen of Worcester granting the Connecticut River Transmission Company the right to erect and maintain poles and wires over certain avenues and streets in Worcester. This right was protested by the Worcester Electric Light Company, which claimed an exclusive privilege in that city. This approval by the Gas Commission means that the Connecticut Company will enter into competition with the Worcester Company for the sale of energy, but it cannot supply customers who want less than 300 hp.

LOS ANGELES FIRE-ALARM CONTRACT.—It is reported that the contract for supplying fire-alarm and police-alarm signal systems in the University District of Los Angeles, to which reference was made in these columns last week, has been awarded to the Cregier Signal Company of Chicago, which, it is said, is to furnish and install 100 boxes at a cost of $29,274. It is believed to be the intention of the city to abandon the automatic system and to install district manual stations.

TWIN CITY RAPID TRANSIT COMPANY.—The contest between the Twin City Rapid Transit Company and the City of Minneapolis will come up before the Supreme Court of the United States within the next few days. The city endeavored to enforce a six for a quarter fare ordinance some years ago, and the United States Circuit Court decided in favor of the company. Since then the matter has been in the Supreme Court, and a decision is expected some time this month.

DENVER GAS & ELECTRIC COMPANY BUILDING.—The contract for installing feeders, panel boards and decorative outside lighting in the Denver Gas & Electric Company's 10-story office building now under construction at Denver, has been given to J. Fischer, electrical engineer, of Denver. Mr. Fischer largely assisted in the design of the special outlining for the building, and in many details of the specification. The completed installation will cost in the neighborhood of $30,000.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Almorgordo, N. M.; Marblehead, Mass.; Montesano, Wash.; Meredith Center, N. H.; Lorain, Ohio; Massapequa, N. Y.; Marshall, N. C.; Greenville, S. C.; Dublin, Ga.; Blackwell, Okla.; Sandpoint, Idaho; Spirit Lake, Idaho; Redlands, Cal., and Reno, Nev.

ALLIS-CHALMERS COMPANY.—The Allis-Chalmers Company is perfecting plans to make extensive improvements in its Cincinnati plant. It is given out that the business in the electrical manufacturing branch of this company has increased so rapidly that the present plant is inadequate to take care of it. In consequence quite extensive additions are to be made in Cincinnati, and several hundred additional workmen will be employed.

NEW YORK ELECTRIC CONSUMERS' LEAGUE.—A company was incorporated in Albany last week with a nominal capital of $500 to be known as the "State Electric Consumers' League" of New York. The purpose of this company is to furnish inspection and auditing for private consumers of electric energy or gas for power or lighting, and to examine wires, pipes and conduits.

ELECTRIC FOUNDRY ADDITION.—Preparations are being made to open the new foundry addition to the Fort Wayne (Ind.) Electric Works, which was finished several months ago. Expert workmen have been working on the installation of the necessary apparatus, and a narrow-gage railroad will be built from the present factory buildings to the foundry.

FABIUS HENRION CARBONS.—The Edward E. Cary Company, importer, which controls the "Fabius Henrion" lamp carbons in this country, has just closed a contract with the Stuart-Howland Company, of Boston, by which that company became the exclusive selling agent of these carbons in New England.

ISTHMIAN CANAL SUPPLIES.—The Isthmian Canal Commission, Washington, invites proposals until Nov. 12 for a 6-in. induction-motor driven pump, with transformer, switches, etc.

Financial Intelligence.

THE WEEK IN WALL STREET.

During the week the stock market has been rather dull in trading, but a confident tone has prevailed, and the majority of the net changes for the week have been slight gains. There might be given as the principal feature of the market the widespread spirit of conservatism that apparently dominates all transaction. The bankers are conservative about placing loans, the large traders are conservative in assuming heavy commitments, and the small traders are compelled to be conservative because they can only expend when the banks are liberal. The entire situation is the result of the unsettled condition of the European money market. Our own money market is in an exceptionally good condition for the season of heaviest demand from the West for crop moving purposes. We have met this demand without strain, and but for the fact that our market is very sensitive to European conditions there would be no fear of stringency here. As it is, there is the ever present fear of further advances in the discount rates of the German Imperial Bank and the Bank of England, with rates of exchange already so high as to bring about exports of gold. It is this uncertainty, more than the present price of money, that unsettles trading and induces conservatism. The important features of the week were the proposed new stock issues of the Pennsylvania and New York Central Railroads, aggregating $124,000,000—each of which will be an added strain to the money market—and the evident negotiations among the great copper producers to form a trade agreement or possibly a pooling arrangement. This latter had the effect of strengthening Amalgamated copper stock and making it one of the most active

issues on the list. The activity of Interborough-Metropolitan continues to be a noticeable feature of the trading, although there has been no advance. Bonds continue to be in good, although less urgent, demand for investment purposes. Money was quoted Nov. 8: Call, 3¼ @ 5 per cent; 90 days, 4¾ @ 5 per cent. Quotations in the table are those of the close, Nov. 8.

NEW YORK.

	Oct. 30.	Nov. 8.	Shares sold.		Oct. 30.	Nov. 8.	Shares sold.
All.-Ch.	15½	15¾	8,800	Int.-Met., pfd.	50⅜	50⅛	22,600
All.-Ch., pfd..	52½	54¾	17,658	Mackay Cos..	91¼	94⅜	4,500
Amal. Cop...	86¼	89	411,200	MackayC.,pfd.	75½	76*	600
Am. D. T....	20½*	20½*	.....	Man. Elev....	142	142¾*	120
Am. Loc.....	62	62⅜	20,825	Met. St. Ry..	24*	24¾*	100
Am. Loc.,pfd.	116	116	400	N.Y.&N.J.Tel.	139¼*	139¼*	.....
Am. Tel. & C.	85*	85*	.....	Steel, com...	90⅝	90¾	765,650
Am. T. & T..	141¼	140¼	8,250	Steel, pfd....	128	127	15,267
B. R. T.....	76	76½	8,515	W. U. T.....	77	77¼	2,200
Gen. Elec....	164	163¾	2,545	West'h., com.	87	86½*	7,800
Int.-Met.,com.	19¾	20	67,400	West'h., pfd.	140*	140*	300

PHILADELPHIA.

	Oct. 30.	Nov. 8.		Oct. 30.	Nov. 8.
Am. Rys.....	45½*	45¾	Phila. Elec.....	13⅜	13¼
Elec. Co. of A.....	12½*	12⅜	Phila. R. T.....	25¾	27½
Elec. St. B'ty.....	58*	58½	Phila. Trac.....	89½*	89*
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	51¾	53½

CHICAGO.

	Oct. 30.	Nov. 8.		Oct. 30.	Nov. 8.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	136½	136½
Chi. Rs., Ser. 1.....	108*	108*	Met. El., Com.....	16½*	17*
Chi. Rs., Ser. 2.....	35½*	34*	Met. El., pfd.....	51¾	52
Com. Edison.....	119¼	119½	Nat'l Carbon.....	97	97*
Chi. Subways.....	7*	7¼	Nat'l Car., pfd.....	120*	120*

BOSTON.

	Oct. 30.	Nov. 8.		Oct. 30.	Nov. 8.
Am. T. & T.....	141½	140	Mex. Tel.....	3¼*	3¼*
Cum. Tel.....	147¼	146	Mex. Tel., pfd.....	6*	6*
Edison E. Ill.....	252*	250	N. E. Tel.....	135	134
Gen. Elec.....	163*	162	W. T. & T.....	10⅞*	11
Mass. E. Ry.....	18½	18½	W. T. & T., pfd.....	89*	89*
Mass. E. R., pfd....	82	84			

* Last price quoted.
Shares sold are for week of Nov. 1 to Nov. 6.

HILL ACQUIRES SPOKANE & INLAND EMPIRE ELECTRIC LINES.—It is practically admitted that James J. Hill, representing the Northwestern Improvement Company, a subsidiary of the Northern Pacific Railroad, has acquired the holdings of Jay P. Graves in the Spokane & Inland Empire Railroad Company. As the Great Northern already owned a large interest in the stock of this company, this purchase gives Mr. Hill control of the property. It is said that the Chicago, Milwaukee & Puget Sound Railroad Company, part of the St. Paul system, was negotiating for the Graves interests. The Inland Empire Company is capitalized at $10,000,000 preferred and $10,000,000 common stock. All of the common is issued, while half of the preferred is still retained in the treasury. The company has a total of 390 miles of track in operation, and has constructed extensive hydroelectric plants on the Spokane River. In addition to a full equipment of cars, it possesses 76 motor cars, nine electric and five steam locomotives. Although several recent dividends have been passed, the company is said to be in a very prosperous condition and in excellent physical shape.

COMMONWEALTH EDISON COMPANY'S REPORT.—The annual report of the Commonwealth Edison Company, of Chicago, for the fiscal year which ended Sept. 30, 1909, just made public, shows gross income of $10,639,448, an increase of $1,138,339 over the previous year. The operating expenses increased only $268,115, and the net earnings were $3,996,753, an increase of $870,424. During the year a sum of $427,250 was charged off for depreciation, and the net balance at the end of the year for dividends was $2,386,996, being equal to 7.95 per cent on the $30,000,000 capital stock. The report indicates that the business of the company has increased rapidly during the year, and that there is every promise of further development. At the end of the fiscal year the company had connected the equivalent of 4,920,800 standard 16-cp lamps, an increase of 783,150 over the previous year. At a special meeting of the stockholders an increase of $10,000,000 was authorized in the capital stock. This new stock will be issued as needed, and it is said that the company proposes to supply its needs for capital hereafter by increasing its stock rather than by issuing bonds. The managers believe it is better to pay 6 per cent on bonds owned around Chicago and non-taxable rather than 5 per cent on bonds mainly owned by outsiders.

NEW HAVEN COMPANY BUYS TROLLEY LINE.—Richard Sutro, of Sutro Brothers, representing the New York, New Haven & Hartford Railroad Company, purchased last week at foreclosure sale the greater part of the Tarrytown, White Plains & Mamaroneck Railroad. The price paid was $825,000, and the sale was made to cover a $500,000 foreclosure action brought by the Knickerbocker Trust Company. The line was sold in three sections, the first two of which were purchased by Mr. Sutro. Section one extends from Mamaroneck to Tarrytown, a distance of 16½ miles; section two extends from White Plains to Scarsdale, a distance of five miles; and the third section of the road, which extends from Mamaroneck to Larchmont, two miles, was purchased by F. J. Littlebrook, representing the bondholders' committee of the Third Avenue Railroad Company. These purchases are supposed to be part of the plan of the New Haven railroad to control the traction situation in Westchester County.

TO BUILD WHITE PLAINS ROAD.—President L. S. Miller, of the New York, Westchester & Boston Railway Company, announces that he will proceed at once with the construction of a line to White Plains, in addition to the line that is now being built through the Bronx and the Sound shore section of Westchester County. The White Plains division has been divided into two sections, one of which will be built by the Ferguson Construction Company and the other by Henry Steers. The branch leaves the main line near Columbus Avenue, Mount Vernon, and will be about 10 miles in length. Its northern terminus will be White Plains. Work is already well advanced on the main line of the road between 135th Street and the Harlem River, and New Rochelle. This road is unique in the fact that it is being constructed fully up to the standard of heavy steam railroads, but is intended for electrical operation exclusively to handle suburban traffic. It is the property of the New York, New Haven & Hartford, and the construction is being financed by that company.

BAN ON TRACTION MERGERS.—Attorney-General Stead, of Illinois, has rendered an opinion in which he holds that a "commercial" railway company and a street railway company cannot legally consolidate. This bars interurban and street railways from merging, as well as steam railways and street railways. It is expected that the matter will be threshed out in the courts.

OKLAHOMA GAS & ELECTRIC COMPANY.—N. W. Harris & Company have purchased $1,600,000 of the first mortgage 5 per cent 20-year bonds of the Oklahoma Gas & Electric Company, of Oklahoma City. These bonds will probably be offered to the public in the near future.

MASSACHUSETTS ELECTRIC COMPANIES.—For the 12 months which ended Sept. 30, 1909, the Massachusetts Electric Companies reported a surplus, after having paid preferred dividends, of $1,083,860. This is the largest surplus that the company has ever earned, and equals 5.2 per cent on the $20,557,400 of preferred stock of the holding company. During the year the company charged off something like $200,00J for maintenance expenses.

BOSTON ELEVATED REPORT.—The report of the Boston Elevated Railway Company for the fiscal year ending Sept. 30 shows gross earnings of $14,493,853, or 2.9 per cent better than for 1908. The operating expenses were $9,488,483, or 65.4 per cent of the gross, compared with $9,454,385, or 67.1 per cent of the gross for the previous year. The operating ratio is the lowest in the history of the company. In the year the company carried 281,000,000 passengers, an increase of 8,000,000. This traffic was handled by a car operation of 51,127,000 car miles, compared with 51,625,000 car miles the year before.

ST. LAWRENCE RIVER POWER COMPANY.—The Canadian and American Interests which are seeking authority to develop the water-power by damming the St. Lawrence River at Brockville have applied to the Canadian Government with a revised plan. They propose to dam the whole river from the Canadian to the New York shore, and to make use of the entire power of the Long Sault Rapids. The dam will raise the river at Ottawa about 18 in. This new movement is a combination of the interests of the St. Lawrence Power Company, of Canada, and the Long Sault Development Company, of New York.

MEXICAN NORTHERN POWER COMPANY BONDS.—A meeting of the bondholders of the Mexican Northern Power Company, Limited, will be held at the company's office in Montreal on Nov. 17 for the purpose of increasing the bond issue of the company to $10,000,000.

INCREASED EARNINGS FOR MACKAY COMPANIES.—The new cable of the Commercial Cable Company between New York and Newfoundland has proved a great success, according to statements made by officials of the Mackay companies, has added a large amount to the earnings of the Cable company and has enabled it to handle business with much greater facility. It is not improbable that within a short time another cable connection will be made over practically the same route. The only thing that is deferring this work at the present time is the complication with the Government of the Province of Newfoundland. While there has been a decided increase in the entire business of the Mackay companies, it is said that at the present time there is no intention of increasing the dividend rate beyond the 4 per cent which has prevailed since 1904. This rate is paid on both preferred and common stock. Mr. Mackay has just finished an 8000-mile inspection tour of the Postal Telegraph lines. In discussing the conditions in the Far West, he said that within the last 12 months the business of his lines in that section had increased remarkably, and that within a short time he would complete the construction of a new transcontinental line direct between San Francisco and Salt Lake, via Reno. He said the construction of this line had been a serious undertaking on account of the difficulty of obtaining private rights-of-way, and the necessity of imbedding the poles in solid rock across the Sierras for about 40 miles. Messages are already being sent over this new line between San Francisco and Reno.

ROCKINGHAM (N. C.) POWER COMPANY.—A further statement relative to the recent Supreme Court decision in the case of Worth vs. the Knickerbocker Trust Company, Warner, Mitchell and Hugh McRae & Company, in the Rockingham (N. C.) Power Company case, has been made by an attorney for the trust company, who thinks that the first publication might have been misleading. He states that the sale was made by the court's order and the property purchased by a reorganization committee having in hand all of the bonds except a few held by Mr. Worth. The suit in the Supreme Court is that of Mr. Worth, who is seeking damages, alleging false representations as to the value of the stock he purchased. This statement, says the attorney, is an injustice to the Rockingham Power Company and its successor, they not being affected by the decision.

MORE STOCK FOR NEW YORK CENTRAL.—The New York Central & Hudson River Railroad Company has applied to the Public Service Commission of the Second District of New York for permission to issue 446,580 shares of new stock. The present outstanding stock of this railroad is $178,632,000, and the new issue represents a 25 per cent increase. It will be offered to the present shareholders at the ratio of one share of new stock for each four shares now held. The majority of this new issue is to be used for taking up outstanding obligations. Six million dollars will be devoted to the electrification of the Harlem Division to North White Plains. The $25,000,000 worth of new equipment which has recently been ordered by the road will not be paid for by the proceeds of this new issue of stock, but will be taken care of by some other plan of financing.

TELEPHONE CONSOLIDATION HALTED.—An application has been made for a receiver at Cleveland for the Youngstown Telephone Company, the Columbiana County Telephone Company and the Intercity Telephone Company. This application was made by the National Telephone Company, of Wheeling, W. Va. This action was thought to have a bearing on the recent deal in which James Brailey, Jr., of Toledo, obtained control of the United States Telephone Company. The lines named are owned by the United States company, and the National company declares that a contract of sale to it had been made which has now been violated. The receivership is asked only for a period sufficient to cover the time necessary to enforce this contract.

CAROLINA TRACTION COMPANY.—The Carolina Traction Company, of Rock Hill, has been chartered in South Carolina by W. S. Lee, Jr., manager of the Southern Power Company, Charlotte, S. C.; George Stephens, president of the American Trust Company, Charlotte, and J. M. Cherry, Rock Hill. The capitalization will be $500,000. This company proposes to develop a system of rural trolley lines radiating from Rock Hill, and to build lines to Charlotte, 25 miles north, and to Lancaster, and to tap the Seaboard Air Line in Chester County. It is believed that energy for the system will be derived entirely from the Southern Power Company.

CUBAN TELEPHONE COMPANY.—The recent bond issue of the Cuban Telephone Company has been placed in London. The authorized issue was for £2,000,000, and the price at which it was offered to the English investing public was 92 per cent. At this time £1,050,000 have been placed. These are 5 per cent bonds, and are redeemable by the company at 105 after June 30, 1921. The principal subsidiary of this company is the Havana Telephone Company, which, it is said, is earning at the present time $200,000 per year above its fixed charges.

CONTINENTAL TELEGRAPH & TELEPHONE COMPANY.—Negotiations have been completed whereby the control of the Interstate Telephone & Telegraph Company, of New Jersey, will pass to the recently organized Continental Telegraph & Telephone Company. The purposes of this company were outlined in a recent issue, and it is expected that it will eventually become the holding company for the independent telephone interests between the Atlantic Ocean and the Rocky Mountains.

THIRD AVENUE FORECLOSURE SALE.—The foreclosure sale of the Third Avenue Railroad Company has again been postponed. Judge Lacombe, of the United States District Court, has now set Jan. 11, 1910, as the date of the sale. This postponement was made in order to permit the bondholders committee to formulate a new plan of reorganization, the plan proposed several months ago having been turned down by the Public Service Commission.

WESTBORO (MASS.) GAS & ELECTRIC COMPANY.—The Westboro Gas & Electric Company has applied to the Gas Commissioners of Massachusetts for permission to make a new stock issue of $29,500. The company will buy its energy from the Connecticut River Power Company.

DIVIDENDS.

American Smelters Securities Company, quarterly, 1½ per cent on preferred A, 1¼ per cent on preferred B, both payable Dec. 1.

American Telegraph & Cable Company, quarterly, 1¼ per cent, payable Dec. 1.

Columbus (Ohio) Edison Company, quarterly, 1¼ per cent, payable Dec. 1.

Massachusetts Gas Companies, preferred, semi-annual, 2 per cent; common, four months, 1 per cent, both payable Dec. 1.

National Carbon Company, preferred, quarterly, 1¾ per cent, payable Nov. 15.

Niles-Bement-Pond Company, preferred, quarterly, 1½ per cent, payable Nov. 15; common, quarterly, 1½ per cent, payable Dec. 20.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Changes.	Surplus.
Boston & Worcester Street Railway Company:					
Year ended Sept. 30, 1909	$577,510	$321,093	$256,417	$178,954	$77,463
Year ended Sept. 30, 1908	553,613	282,917	270,696	155,965	114,731
Boston Elevated Railway Company:					
Year ended Sept. 30, 1909	14,493,853	9,488,484	5,005,369	4,163,951	841,417
Year ended Sept. 30, 1908	14,074,696	9,454,386	4,620,310	3,780,246	840,064
Commonwealth Edison Company:					
Year ended Sept. 30, 1909	10,639,446	6,642,693	3,996,752	1,182,506	2,814,246
Year ended Sept. 30, 1908	9,500,907	6,374,578	3,126,329	1,032,625	2,093,704
Cumberland Telephone & Telegraph Company:					
September, 1909	533,329	342,981	190,348	.....	.....
September, 1908	508,130	332,485	175,645	.....	.....
Montreal Street Railway Company:					
Year ended Sept. 30, 1909	3,874,838	2,255,019	1,619,819	445,749	1,229,676
Year ended Sept. 30, 1908	3,677,432	2,158,394	1,519,038	454,638	1,136,411
New York, New Haven & Hartford Railroad Company:					
September, 1909	5,354,172	3,164,420	2,325,057	.....	.....
September, 1908	4,819,232	3,157,212	1,799,854	.....	.....
Philadelphia Company:					
Nine months ended Sept. 30, 1909	13,210,150	7,527,754	5,682,396	3,437,624	2,466,871
Nine months ended Sept. 30, 1908	12,261,314	7,453,833	4,807,481	3,351,513	1,649,892

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—It is reported that the Corey Land Company organized with a capital stock of $500,000, has purchased a tract of land adjoining that recently purchased by the Tennessee Coal, Iron & Railroad Company as a site for large coke plant. The Corey Land Company, it is said, will build a large industrial city to provide for the employees of the Tennessee company's plants. Among the improvements to be installed will be electrical service, electric-car service and water and gas supply. The town site is located between Ensley and Wylam and will be named Gary. Robt. Jemison, Jr., is president of the company and A. B. Tanner is secretary and treasurer.

GADSDEN, ALA.—Local business men are considering the question of constructing an electric railway from Gadsden to South Gadsden, for which $50,000 has already been pledged. It is thought that an attractive bonus may be offered to the Alabama City, Gadsden & Attalla Railway Company to extend its railway system to that section of the city. The company is now building an extension from Gadsden to Attalla.

PARKER, ARIZ.—The Arizona Empire Copper Mines Company contemplates the installation of a power plant, the equipment of which will include an engine, generator, motors, air compressor and ore reduction machinery.

STODDARD, ARIX.—The Stoddard Mines Company is reported to be making preparations for the construction of an electric power plant.

HOT SPRINGS, ARK.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 6, for the construction, including heating apparatus, electric conduits and wiring, gas piping, etc., of an extension, remodeling, etc. to the U. S. post office at Hot Springs, Ark., in accordance with plans and specifications, copies of which may be obtained from the custodian at Hot Springs or at the above office. James Knox Taylor is supervising architect.

NASHVILLE, ARK.—B. H. Rainwater, of Junction City, Ark., is contemplating installing an electric light plant in Nashville.

CASTELLA, CAL.—Benjamin Johnson has appropriated 8,000 cu. in. of water on Castle Creek, near where Echo Lake empties into the creek. It is said that the water will be conveyed a mile and one-half to the North Star group of mines, where it will be utilized to generate electricity to operate the mill and mines.

GENESEE, CAL.—The construction of an electric power plant and concentrating mill is under consideration by the Five Bears Mining Company, in Genesee.

INDEPENDENCE, CAL.—J. E. Eibeshutz has been granted permission to erect transmission lines on the public highways in Independence.

LEASTALK, CAL.—The Garavanza Mining & Milling Company, of Leastalk, is contemplating the construction of a new power plant.

LOS ANGELES, CAL.—The Board of Supervisors has granted W. M. Bowen a franchise for the extension of the street railway system on West Adams Street from the present terminus. Mr. Bowen bid $100 for the franchise.

OAKLAND, CAL.—The City Council has granted the Great Western Power Company a franchise to erect transmission lines in Oakland for the distribution of electricity for lamps, heat and motors. It has not yet been decided whether the company will be permitted to erect its high-tension lines from the head of Fourth Avenue over Fifth or Thirteenth Avenue to its distributing station at Session's Basin. The company paid $200 for the franchise.

OROVILLE, CAL.—The Sacramento Valley Power Company, which proposes to extend its transmission lines from Redding to Chico, also plans to extend its service to Oroville. The company will not only furnish electricity in Oroville but will also furnish electrical service to farmers to operate pumping plants. The transmission line will pass through Anderson, Cottonwood, Red Bluff, Tehama and Corning.

PETALUMA, CAL.—The Highland Pacific Electric Railway Company, which is now securing rights of way from Lakeport, via Cloverdale to Santa Rosa, to construct and operate an electric railway in this district, is contemplating extending the railway to Tidewater, via McNear's Point. A movement is on foot to secure control of the Santa Rosa, Sebastopol & Petaluma Electric Railway, or to provide traffic arrangements over it. The company is capitalized at $2,500,000, and proposes to construct about 75 miles of road. Dr. A. Dickinson is president of the company.

REDLANDS, CAL.—The Holton Power Company, it is said, is planning to increase the equipment of its power plant, which will include a hydraulic turbine unit of 1000 hp, transforming apparatus, etc.

SAN FRANCISCO, CAL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 18 for power plant, including boilers, engines, electric generators, switchboard, conduits, wiring, heating and ventilating apparatus, deep well pumps and vacuum cleaning apparatus for the United States custom house and appraiser's stores building in San Francisco, Cal., in accordance with plans and specifications, copies of which may be obtained at the above office or at the office of the architects, Eames & Young, Wright Building, St. Louis, Mo. James Knox Taylor is supervising architect.

YOUNTVILLE, CAL.—It is reported that the directors of the Veterans' Home have contracted with the Snow Mountain Power Company to furnish electricity to the institution for lamps and motors.

CEDAR, COL.—Plans have been filed with the state engineer for the Custer reservoir in San Miguel and Dolores counties, work on construction of which was commenced in October. The dam will be 110 ft. in height and will create a storage capacity of 756,800 cu. ft. of water and will cost about $200,000. The water will be used for the development of power and for irrigation purposes. M. J. Bailey, of Cedar, Col., is interested in the project.

COLORADO SPRINGS, COL.—Twelve miles of the pipe line from the Nederland to the Kosler reservoir has been completed by the Central Colorado Power Company, by which a drop of 1860 ft. to the power house on Middle Boulder Creek is secured. The steel pressure pipe, which will sustain a pressure of 800 lb. to the sq. in., is now being placed. The power house is completed and most of the machinery installed. With the exception of the dam the power project will be practically completed by Jan. 1. The initial installation will be 10,000 kw, supplementing the Shoshone plant of the Central Colorado Power Company, now furnishing energy to the Denver Gas & Electric Company, of Denver.

DENVER, COL.—The Williamson-Hafner Printing Company, of Denver, Col., is having plans and specifications prepared for a new building, 225 by 125, two-story, of fire-proof construction and sprinkled; the entire plant is to be equipped to be operated by electricity. A 2200-volt motor will drive a 110-volt, direct-current generator and individual motor drive will be utilized throughout. The motor arrangements will include enclosed type motors and geared connections. The building will be lighted by a system of tungsten lamps planned by the illuminating engineer of the Denver Gas & Electric Company.

GEORGETOWN, COL.—Extensive improvements and changes are being made to the American Sisters' power plant in Georgetown, for the purpose of improving the service.

LAMAR, COL.—The Lamar Electric Light Company is contemplating extending its transmission lines.

ORDWAY, COL.—The Ordway Electric Light & Power Company is extending its transmission lines to supply electricity in the town of Sugar City, some five miles distant. Both these towns are in the sugar district and considerable irrigation load is being developed. It is claimed that service will be furnished in Sugar City by Jan. 1, notwithstanding that the Ordway power plant was badly damaged by fire on Nov. 2. Machinery for the temporary replacing of the plant is being rushed to Ordway by the Hendrie & Bolthoff Manufacturing & Supply Company, of Denver.

ROUSE, COL.—The town of Rouse, Col., is being wired for the distribution of electricity for lamps and motors. The service will be supplied from the high-tension lines of the Southern Colorado Power Company, which have been extended to include this district.

COLCHESTER, CONN.—Plans are being considered by the National Shoe Supply Company for the installation of an electric plant to furnish electricity for lighting its works. If sufficient encouragement is given the company will install a plant with sufficient output to light the town.

NEW HAVEN, CONN.—The contract for the construction of the electric railway which is to extend from New Haven to Irvington, Conn., has been awarded to Joseph Lyons.

PORTLAND, CONN.—Arrangements are being made by the Rogers & Hubbard Company to install both electric light and gas lighting systems in its large plant, recently erected. The equipment of the electric plant will include a generator, which has already been purchased; also two 60-hp gas engines and a 10-hp steam engine.

ELLENDALE, DEL.—The question of establishing an electric light plant in Ellendale is reported to be under consideration.

WILMINGTON, DEL.—The Board of Water Commissioners on Nov. 1 awarded the Westinghouse Electric & Manufacturing Company the contract for generator and switchboard for the filter plant, at $1,510; the contract for installing the plant was awarded to Garrett, Miller & Company, for $4,072.

GREEN COVE SPRINGS, FLA.—At an election held recently the citizens voted to issue bonds to the amount of $45,000, the proceeds to be used for the erection of a municipal electric light plant, water works system and building new roads and sidewalks. The town has not yet decided whether it will purchase the present system or build a new plant. The cost of the electric light plant is estimated at about $10,000.

DUBLIN, GA.—The City Council is considering plans for improvements to the municipal electric light plant and water works system,

which will include the installation of a 500-hp boiler, engine and generator.

HAWKINSVILLE, GA.—The City Council has employed J. B. McCrary & Company, of Atlanta, Ga., to take charge of the construction of the municipal electric light plant, contracts for construction of which were recently awarded.

WAYCROSS, GA.—Application has been made to the City Council for a franchise to furnish electricity for lamps and gas for fuel in Waycross, by Burdette Loomis, president of the Waycross Gas & Construction Company. It is reported that the company has made arrangements for financing the construction of a wood-distilling plant, to cost $500,000, to be located in the pine belt, between Savannah and Jacksonville. The company proposes to utilize large quantities of refuse wood for generating electricity and fuel gas. Negotiations, it is said, are now under way for purchasing the property for the plants.

GREER, IDAHO.—The Lolo Milling & Mining Company is reported to have secured water rights on the Lolo River and an option on the Carlson farm, where it proposes to erect a large power plant.

SANDPOINT, IDAHO.—The Idaho Power & Concentrating Company is reported to have completed plans for its proposed construction work next spring. It is said that contracts will be awarded at once for the construction of dams and flumes on Trestle Creek, the cost of which is estimated at $12,000.

SPIRIT LAKE, IDAHO.—The Panhandle Company, of Spirit Lake, is reported to be preparing to increase the output of its power plant for operating its planing mill. The equipment will include two 100-hp steam turbines, with exciters, condensers and motors.

CHICAGO, ILL.—The directors of the Commonwealth Edison Company have recommended to the stockholders an increase of $10,000,000 in the company's capital stock, to be issued from time to time as deemed advisable by the directors. If the recommendation is adopted by the stockholders it is probable that an increase of $3,000,000 will be offered for subscription to the stockholders at par in February, to be paid in instalments.

CLINTON, ILL.—The City Council is considering an ordinance to issue $20,000 in bonds for the construction of an electric light plant and water works system. The question will be submitted to a vote of the people. L. W. Lemon is city engineer.

BRAZIL, IND.—The Vigo County Electric Company, which recently secured control of the plant of the Brazil Electric Light Company in Brazil, has been granted a franchise by the County Commissioners to erect a high-tension transmission line through the county. The company proposes to erect a transmission line to Greencastle, Ind., for the purpose of furnishing electricity for lamps and motors in that city. Work on construction of the line will commence at once.

ELKHART, IND.—The Nickel Plate Railroad contemplates the use of telephones in dispatching trains in Indiana. Twenty-eight regular stations are to be equipped with a number of special siding telephones. The equipment used will consist of the standard Western Electric telephone train-dispatching apparatus and Gill selectors.

FT. WAYNE, IND.—The directors of the Home Telephone & Telegraph Company have announced that new equipment will be purchased for the South Branch station on Calhoun Street, which will involve an expenditure of $4,000.

ROANOKE, IND.—The Ft. Wayne & Wabash Valley Traction Company has contracted with the Town Board to furnish electricity to light the streets of the town. Lamps of the Wood magnetite type will be installed. The company is also negotiating with the Town Trustees of Ossian to furnish electrical service in that town. If present plans are carried out the Traction company will soon be furnishing electrical service in all the towns on its system between Ft. Wayne and Lafayette.

BETTENDORF (P. O. DAVENPORT), IA.—We are informed that the Bettendorf Axle Company will furnish power for operating the plant of the Bettendorf Improvement Company which proposes to furnish electricity for lighting the town of Bettendorf.

DES MOINES, IA.—Bids will be received by the City Council at the office of George F. Poorman, city clerk, until Dec. 1, 1909, for the construction of a city hall, including heating, electrical work and plumbing, as per plans and specifications now on file at the office of the city clerk.

DES MOINES, IA.—An agreement has been entered into between the Red Oak & Western Railway Company and the Des Moines, Council Bluffs & Western Railroad Company whereby an interurban railway will be built from Des Moines to Red Oak in the near future. According to the present plans the Red Oak company will build the railway from Red Oak to Stuart, and the Des Moines company will start at Des Moines and connect with the Red Oak company at Stuart. It is understood that the two companies will eventually consolidate. The combined capital of the two companies amounts to $500,000.

DES MOINES, IA.—William B. McKinley, president of the Illinois Traction System, Champaign, Ill., and associates, who have secured an option on the property of the Des Moines City Railway Company and the Inter-Urban Railway Company have agreed to make the following improvements to the railway system in Des Moines in return for a 25-year franchise in this city: To remove all present unused tracks, rebuild at once 10 miles of track with 120-lb. girder rail on paved streets and 80-lb. T-rail on unpaved streets, purchase 50 new cars, construct 50 miles of new track within the city limits, cast or electrically weld all joints on new track, construct a new power house to cost $250,000, place all feed and transmission wires underground in the fire district and use iron poles wherever there is permanent construction and paved streets. The question of fare, the division of gross receipts and the right of the city to purchase the property in the future have not yet been agreed upon.

KENSETT, IA.—The directors of the Kensett Mill & Light Company have decided to enlarge and improve its electric plant. A new generator will be installed.

OTTUMWA, IA.—Frank Turner is reported to be interested in a project for the construction of an interurban railway to Iowa City.

SIOUX CITY, IA.—The electric department of the Sioux City Gas & Electric Company will be sold to the Sioux City Service Company if the citizens will allow the sale. At the time the question of the sale of the plant is submitted to the people the gas company will ask for a new franchise omitting the clause giving the city permission to purchase the plant. In order to make the proposed sale it will be necessary for both companies to ask for new franchises. It is said that the companies are willing to continue paying the city 2 per cent of the gross earnings, but neither is willing to grant the city the right to purchase the plants within the period of the franchise, which will be 25 years.

MARION, KAN.—Plans are being prepared by Burns & McDonnell, consulting engineers, Kansas City, Mo., for an electric light plant and water-works system for Marion. The cost of the electric plant is estimated at $12,000 and the water works at $48,000. Bids for the construction of the plant will be called for in the near future. Thomas W. Bowen is city clerk.

CARLISLE, KY.—The City Council has passed an ordinance providing for the sale of a telephone franchise, which is said to have been applied for by the East Tennessee Telephone Company.

PORTLAND, MAINE.—Bids will be received by the city hall building committee until Dec. 1 for electric work, heating and ventilation of the new city hall in Portland, Maine. Plans and specifications can be seen at the offices of the architects, Carrere & Hastings, 225 Fifth Avenue, New York, N. Y., or John Calvin Stevens and John Howard Stevens, 187 Middle Street, Portland, Maine. Full set of plans and specifications may be purchased at actual cost for personal use. Proposals must be submitted on blanks provided by the architects. Adam P. Leighton, John F. A. Merrill and Richard C. Payson are commissioners.

POCOMOKE, MD.—Plans for the construction of an electric light plant in Pocomoke are being prepared by Theodore W. P. Pietsch, of Baltimore, Md.

MARBLEHEAD, MASS.—At a special town meeting held recently the citizens voted to appropriate $30,000 for the reconstruction of the municipal electric light plant as recommended by the committee appointed to investigate the plant. The municipal electric light commissioners and the investigating committee were appointed to take charge of making the improvements.

PITTSFIELD, MASS.—P. J. Moore has petitioned the City Council for a franchise to construct and operate a gasoline-electric railway in the eastern portion of Pittsfield, Mass.

WESTBORO, MASS.—The Westboro Gas & Electric Company has applied to the State Board of Gas and Electric Light Commissioners for permission to issue $29,500 additional capital stock, the proceeds to be used for refunding $9,000 in bonds and coupon notes amounting to $9,000 and the balance for additions and improvements to its system. The company has recently closed a deal whereby it will secure electricity from the Connecticut River Power Transmission Company through the Marlboro Electric Light Company, of Marlboro, Mass.

WORCESTER, MASS.—The Connecticut River Power Transmission Company is reported to have accepted the franchise granted by the City of Worcester, as modified and approved by the State Board of Gas and Electric Light Commissioners. The franchise gives the company permission to furnish electricity to consumers of not less than 300 hp.

BAY CITY, MICH.—The Eastern Michigan Power Company has purchased the property of the New York Salt Works, south of the Interurban bridge, on which it will erect a substation for the distribution of electricity in the Saginaw Valley cities. The company has also decided upon the location of its first dam on the Au Sable River. The dam will be erected in what is known as "Cooke's" in Iosco County, about 14 miles above Au Sable. It is stated that this dam will develop from 3500 to 4000 hp. The cost of the dam, power plant and transmission lines is estimated at $500,000. Electricity generated at the plant will be transmitted to Bay City, Saginaw, Flint, Lapeer, Owosso, Flushing and to cities in other parts of the State.

ECORSE, MICH.—C. E. Haight, proprietor of the local electric light plant, has submitted a proposition to the Village Council for lighting the streets of the village by electricity. At present the streets are lighted by gas, at a cost of $1,000 per year.

GRAND RAPIDS, MICH.—Bids will be received by the city clerk until Nov. 15 for $280,000 in bonds, the proceeds of $100,000 to be used for the purchase of a pumping engine, including electric equipment for the municipal electric light plant.

LANSING, MICH.—The Seager Engine Works, of Lansing, Mich., is reported to be making improvements in the equipment of its plant and will install additional motors.

MT. CLEMENS, MICH.—It is reported that the St. Clair Edison Company contemplates the construction of a large power plant for furnishing electricity in this city and surrounding territory. The present plans contemplate the dismantling of the large plant in Mt. Clemens and furnishing electrical service from the proposed new plant.

SAGINAW, MICH.—The City Council has rejected the franchise submitted by the Chippewa River Power Company asking for a 30-year franchise to furnish electricity for lamps and motors in Saginaw, the service to be furnished within three years, with the privilege of fixing its own prices. It is said that Mr. Pleasant and Alma have granted the company franchises asked. W. F. Davidson is vice-president of the company.

FERGUS FALLS, MINN.—It is reported that the Red River Mill dam, estimated value, $10,000; the Rice dam, valued at $52,000, and the woolen mill dam, valued at $6,000, which were destroyed at the same time the concrete dam owned by the city, together with electric generating machinery, valued at $60,000, owing to the foundation of the city dam being rebuilt on quicksand, will be rebuilt. The city is securing estimates on the supply of electricity to operate the municipal electric system.

MINNEAPOLIS, MINN.—Plans are being considered for extending the illuminating system on Sixth Street from First Avenue South to Fourth Avenue South, and if possible to Sixth Avenue.

SARTELL, MINN.—Preparations are being made for installing a power plant in the new straw board mill of the Watab Pulp & Paper Mill Company, in Sartell, Minn, the equipment of which will include an 800-hp generating unit, a large line of motors for both direct and alternating-current.

WAYZATA, MINN.—Plans are being prepared by the Lake Minnetonka Public Service Company for the construction of a power house, the equipment of which will include two producer gas engines. The cost of the plant is estimated at $20,000. The company was recently reported incorporated to construct an electric light plant to furnish electricity to resorts along the shore of Lake Minnetonka. Henry W. Benton is interested in the project.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Company is contemplating the installation of coal-handling apparatus in its power plant and would like to correspond with manufacturers of coal-handling equipment.

FESTUS, MO.—It is reported that the citizens have voted to issue $15,000 in bonds for a municipal electric light plant.

BILLINGS, MONT.—It is reported that the Billings & Eastern Montana Power Company is contemplating the erection of a transmission line from Billings to Big Timber, work on which will begin at once.

COLUMBIA FALLS, MONT.—The North Idaho & Montana Power Company has applied for a franchise in Columbia Falls to furnish electricity for lamps. The company promises to erect a substation in the town if granted a franchise.

LAUREL, MONT.—A company has been formed by W. R. Westbrook and L. A. Nutting, of Laurel, Mont., for the purpose of constructing an electric railway from Billings and up Clark Fork and Rock Creek.

OAKLAND, NEB.—Negotiations have practically been closed whereby the Oakland Independent Telephone Company will take over the exchange of the Nebraska Telephone Company in Oakland. The closing of the deal, it is said, relies on the decision of the City Council to grant the new company an exclusive franchise to operate in this city. The new company promises to extend and improve the service and reduce rates.

RENO, NEV.—The Reno Power, Light & Water Company, it is reported, will soon commence on the construction of a large electric power plant, west of Reno, on the Truckee River. The proposed plant will cost about $1,000,000, and will furnish electricity to mining camps in different parts of the State. It is also stated that the company will erect plants in other parts of the State to supply electricity in Ely and other cities in that part of Nevada.

BERLIN, N. H.—The Burges Sulphite Fibre Company, of Berlin, N. H., is planning to install two oil-filled, water-cooled 1000-kw transformers in its substation.

MEREDITH CENTER, N. H.—Arrangements are being made to construct an electric light plant in Meredith Center. A dam is being built at Lake Wicwas, which will furnish power to operate a large saw-mill and the power plant. The proposed plant will furnish electricity in this village and in Meredith, which now secures electrical service from the Laconia Electric Lighting Company, of Laconia, 10 miles distant.

MT. VERNON, N. H.—It is reported that the question of installing an electric lighting system in Mt. Vernon is under consideration. If it is decided to establish the system the service will be supplied by the Milford Light & Power Company, of Milford, N. H.

BRIDGETON, N. J.—The contract for lighting the streets of the city for a term of five years was granted to the Bridgeton Electric Company at $10,100 per year.

COLUMBIA, N. J.—It is reported that the Easton Consolidated Service Corporation has consolidated with the Eastern Pennsylvania Power Company, which was incorporated a short time ago, with a capital stock of $2,000,000. The last named company is constructing a large hydroelectric power plant at the mouth of the Paulins Kiln Creek, in Columbia. The company is said to have secured water rights on the Big Bushkill River, in Monroe County, where it will erect another large power plant.

HIGH BRIDGE, N. J.—The Borough Council has granted the Lebanon Telephone Company a 40-year franchise to erect telephone lines on certain streets in the borough.

SOUTH RIVER, N. J.—The Borough Council is considering the question of establishing a municipal electric light plant in South River, the cost not to exceed $12,500. Plans have already been prepared for the plant and are on file at the office of Charles Anderson, city clerk.

ALAMOGORDO, N. M.—The Alamogordo Water Power Company is constructing a large power plant at High Rolls, near Alamogordo, where it will utilize the water from a mountain stream through a pipe line, by which 5000 hp will be developed. The company will supply electricity in the towns of Alamogordo and Tularosa for lamps and motors and also for operating irrigation pumping plants throughout the Tularosa Valley.

DEMING, N. M.—It is reported that contracts have been awarded to the Western Construction Company, of Wichita, Kan., for the construction of an electric pumping plant for the Mimbres Valley. It is said that 40 or 50 wells will be sunk; the initial equipment will include two 400-hp units; about 50 miles of transmission lines will be erected from the plant to the various wells, where direct-connected generators will operate the pumps. For further information address P. M. Shull, of Deming, N. M.

COOPERSTOWN, N. Y.—The property of the Otsego Home Telephone Company will be sold at auction at the court house, Cooperstown, N. Y., Dec. 14, in pursuance to a judgment of foreclosure granted in the Supreme Court at Oneida, Oct. 16. James J. Byard, Jr., of Cooperstown, has been appointed referee and will conduct the sale.

GLOVERSVILLE, N. Y.—The Garoga Light & Power Company, recently incorporated with a capital stock of $50,000, is contemplating asking for a franchise in Johnstown and Gloversville, N. Y. The company proposes to construct a large dam in Garoga Creek and erect a power plant to generate electricity to be transmitted to Gloversville, Johnstown, Fonda, Ephratah and Fultonville. Mortimer Everest, of Gloversville, is interested in the company.

MASSAPEQUA, N. Y.—Plans are being prepared for a water-supply system and an electric light plant in Massapequa to provide both water and electrical service in connection with the development of the Queens Land & Title Company. Both plants will be operated by the Massapequa Water, Light & Power Company, recently incorporated, when completed.

NEW YORK, N. Y.—Contracts have been awarded by the New York, Westchester & Boston Railway Company for the construction of its railway through the Bronx and South shore section of Westchester and to White Plains. The White Plains division has been divided into two sections, one of which will be built by the Ferguson Construction Company and the other by Henry Steers. Work will commence on construction of the railway at once.

NEW YORK, N. Y.—The New York Central Railroad Company has applied to the Public Service Commission for permission to issue $44,658,000 in new capital stock, of which the proceeds of $8,000,000 will be used for new equipment, curve elimination, signal improvement and grade revision on the main line; $6,000,000 will be used for equipping the Harlem division to be operated by electricity, four-tracking on the Hudson division and two-tracking on the Pennsylvania and Rome, Watertown & Ogdensburg divisions.

OSWEGO, N. Y.—Bids will be received at the office of the Department of Public Works until Nov. 23 for lighting the streets and public buildings for a term of five years. The present contract expires Feb. 20, 1910.

PORT JEFFERSON, N. Y.—The North Shore Electric Light & Power Company has applied to the Public Service Commission for permission to construct and operate an electric light plant in Port Jefferson. The town already has electrical service furnished by the Port Jefferson Electric Light Company.

ROCHESTER, N. Y.—Plans are being prepared by the Rochester Railway & Light Company for the illumination of the Cobb Hill reservoir. It is proposed to install 90 large arc lamps or 180 smaller lamps on the crown of the hill, which will be placed on ornamental poles set from 20 to 40 ft. apart.

WILLIAMSVILLE, N. Y.—The Buffalo & Williamsville Electric Railway Company is in the market for a 200-kw converter and three 100-kw transformers.

ANDREWS, N. C.—Plans are being made by the city for the construction of hydroelectric power plant and water works system. The plant will be located about 2½ miles from the city where about 300 hp will be developed. Electricity generated by the plant will be utilized for street and commercial lighting and for industrial plants. H. N. Wells is mayor.

CHARLOTTE, N. C.—Preparations are being made by the Charlotte Consolidated Construction Company for the construction of a short line out of First Street, which will divert a large part of the street railway traffic from a grade crossing to the proposed electric railway to be constructed to the Catawba River, 12 miles distant.

ELIZABETH CITY, N. C.—The exchange of the Elizabeth City & Norfolk Telephone Company was recently damaged by fire to the extent of about $2,000.

MARSHALL, N. C.—Preparations are being made by the North Carolina Electrical Power Company for the construction of a hydroelectric power plant on French Broad River, 2½ miles from Marshall, which will include a dam 500 ft. long and 30 ft. high; stone power house and

the installation of two 2200-hp generators, driven by vertical turbines developing 4600 hp for electrical transmission. High-tension transmission lines will be erected to the company's plant at Ivy, N. C., five miles distant, and from there extending to the plant of the W. T. Weaver Power Company, located five miles from Asheville. The Ivy plant will be the central station for the distribution of energy. Electricity not utilized in Marshall will be transmitted to Asheville, a distance of 19 miles. The company's plant located at Mountain Island, 15 miles from Marshall, has an output of 10,000 hp and will be held in reserve. The cost of the plant is estimated at $400,000. W. T. Weaver, of Asheville, N. C., is president of the company and Charles E. Waddell, of Biltmore, N. C., is engineer in charge.

ROCKY MOUNT, N. C.—Plans have been completed by the Home Telephone Company for extensions to its system through Nash and Wilson counties, extending to the exchange at Spring Hope, Bunn and other points. F. C. Toppleman, of Henderson, N. C., is general manager.

CINCINNATI, OHIO.—Plans have been prepared by City Engineer Sundmaker for the construction of a subway to connect the business section of the city with the outlying part of Cincinnati, which will soon be presented to the City Council. The plans, it is said, have the endorsement of the city administration and will involve an expenditure of from $10,000,000 to $15,000,000 and also contemplates municipal ownership of the proposed subway and urban and interurban traction terminals.

COLUMBIANA, OHIO.—The Columbiana County Telephone Company has installed a new switchboard in its local exchange. Work will soon commence on the erection of an additional toll line from Columbiana to Lisbon, and another from Columbiana to New Waterford.

COLUMBUS, OHIO.—The contract for the construction of the new power plant for the penitentiary has been awarded to R. H. Evans & Co., of Columbus, Ohio, for $53,597, by the Board of Penitentiary Managers. The plant will furnish electricity for lamps and motors for the penitentiary and all of the State buildings in Columbus.

EAST LIVERPOOL, OHIO.—The East Liverpool Traction & Light Company, it is reported, is contemplating extending its interurban railways, the terminals of which are now in Steubenville, Ohio, and Beaver, Pa., from Beaver over the Ohio River at that point and up the river to Aliquippa.

LORAIN, OHIO.—The City Council has voted to appropriate $6,000 for the purchase of a new engine and generator, switchboards, etc., for the municipal electric light plant.

SPRINGFIELD, OHIO.—The American Seeding Machine Company is contemplating increasing the output of its power house and will install a generating unit with a rating of 300 hp.

TIFFIN, OHIO.—The plant of the Consolidated Gas & Light Company was sold by Special Master J. W. Harbaugh at auction Oct. 22 in pursuance of an order from the United States Circuit Court. The consideration was $20,000.

BLACKWELL, OKLA.—The contract for improvements to the electric light plant and water works system has been awarded to Lund & Cunyon, of Blackwell. The power house will be enlarged; generators with a rating of 75 kw and 150 kw will be installed; also Corliss engines and boilers. Plans were prepared by Burns & McDonnell, of Kansas City, Mo.

OKLAHOMA CITY, OKLA.—The Oklahoma Railway Company will place contracts in the near future for stokers and coal-handling apparatus for boilers with a rating of 1600 hp.

OKLAHOMA CITY, OKLA.—At an election held Oct. 29 the citizens voted to grant the Oklahoma Gas & Electric Company two 21-year franchises. Under the terms of the franchises the city will have the right to purchase the lighting plant any time within four years of the expiration of the franchises.

SUPPLY, OKLA.—Bids will be received by the State Board of Public Affairs, Guthrie, Okla., until Nov. 22 for the installation of a heating and power plant at the Hospital for Insane, at Supply, Okla.; plans and specifications will be furnished by P. H. Weathers, architect. Guthrie, Okla. Plans and specifications may be seen at the office of E. G. Newell, superintendent, Supply; State Board of Public Affairs and architect of State Board, Guthrie, Okla. Bidders are asked to include a proposal for a two-ton ice plant to be installed in the same building, plans for which shall accompany bids. Proposals are to be addressed to T. A. Chandler, acting secretary, Guthrie, Okla.

BAKER CITY, ORE.—The report of the water committee submitted to the Council recommends the construction of pipe line about 14 miles in length to secure additional water supply. It is estimated that 6,500,000 gallons daily could be secured and electricity generated to the extent of 512 hp. Estimates of the cost are now being prepared by engineers.

JUNCTION CITY, ORE.—The Northwestern Gas & Electric Company, successor to the Willamette Valley Company, has purchased the electric plant in Junction City, owned by the Howard Electric Company. It is said that the company will soon establish a 24-hour service.

MEDFORD, ORE.—Application has been made to the City Council by John R. Allen, of New York, N. Y., for a franchise to operate an electric railway in Medford. Mr. Allen will apply for similar franchises in Grants Pass and Ashland and intermediate points for the purpose of constructing an electric railway to connect all points in Rogue River Valley.

BENTLEYVILLE, PA.—Arrangements are being made for the construction of an electric light plant and water-works system in Bentleyville. It is understood that the Bentleyville Water Company will install the plant.

ETNA, PA.—A proposition to purchase the municipal electric light plant and water works system is reported to have been submitted to the Borough Council by a company which proposes to construct a large hydroelectric power plant on the Kiskiminetas River and furnish electrical service to towns in the Allegheny Valley. The amount offered by the company will leave a surplus of $60,000 after paying off the bonded indebtedness on the plant. If the Council decides not to sell the plant, it will be necessary to make extensive repairs and improvements, which will involve an expenditure of about $60,000.

EVANS CITY, PA.—A company has been organized in this city under the name of Evans City Light, Heat & Power Company for the purpose of constructing an electric power plant in Evans City to furnish electricity for all purposes. The headquarters of the company will be located in Elwood City. Samuel A. Roelofs, of Elwood City, is interested in the project.

PHILADELPHIA, PA.—George E. Stearns, director of Public Works, has awarded the contract for the installation of the power plant at the Queen Lane filtration plant, now in course of construction, to M. L. Bayard, of Woodbine, N. J., for $76,000.

PHILADELPHIA, PA.—Bids will be received by Joseph H. Klemmer, director of Department of Supplies, until Nov. 15, for supplies for use during the coming year, including under class E, electric cable, wire, lamps, supplies, telephones and instruments. Specifications may be obtained at the office of the director, City Hall, Philadelphia, Pa.

POTTSVILLE, PA.—It is reported that Messrs. Sturges, Haley and other capitalists from Scranton, Pa., are negotiating for a tract of land near Pottsville, where it is proposed to erect a large power plant. The plant, it is said, will be built and operated by the Cass Township Electric Company, recently incorporated. It will furnish electricity to all towns in and around Schuyler County.

CHESTER, S. C.—Both the new and old sections of the Eureka mill plant are being equipped for electric motor drive. It is proposed to operate the entire plant by electricity.

GREENVILLE, S. C.—It is reported that the capital stock of the Broad-ax Power Company will be increased to $250,000 and bonds issued to the amount of $500,000. The holdings of the company were purchased by the United States Guaranty Company, of which John V. Ryan, of Mobile, Ala., is president. The power company proposes to construct a hydroelectric plant on the Saluda River, about six miles from Greenville, where from 4000 hp to 4500 hp can be developed for electrical transmission at a cost of about $1,000,000. It is said that hydraulic and electrical machinery have not yet been purchased.

GREER, S. C.—The City Council is contemplating placing a contract with the Southern Power Company for supplying electricity for lighting the streets and public buildings, or erecting a municipal plant. The city is now negotiating with the company.

FORT MEADE, S. D.—Bids will be received at the office of the constructing quartermaster, Fort Meade, S. D., until Dec. 6, for constructing one double set of quarters for two company officers and four cavalry stables and for installing heating, electric wiring and electric lighting fixtures, etc., in buildings specified. Plans and specifications may be seen at the offices of the chief quartermaster, Department of the Missouri, Omaha, Neb.; Department of the Colorado, Denver, Col.; Department of the Lakes, Chicago, Ill.; Department of Dakota, St. Paul, Minn., and at the above office.

DICKSON, TENN.—The capital stock of the Citizens' Telephone Company has been increased from $3,000 to $6,000.

EAGLE PASS, TEX.—The Chamber of Commerce, of Cuidad Porfirio Diaz, Mex., and the Industrial League of Eagle Pass, are reported to be considering the question of securing the construction of an electric railway to extend from Eagle Pass to San Carlos, a town on the Mexican side of the Rio Grande River. The proposed railway will be about 50 miles long and will run through the irrigated lands of General Lorenzo Trevino, which include about 200,000 acres.

TEXAS CITY, TEX.—The Galveston-Houston Interurban Railway Company has secured a site in Texas City on which it will erect its power plant to furnish electricity for its proposed railway. It is understood that the plant will cost from $750,000 to $800,000.

LOGAN, UTAH.—The Telluride Power Company has submitted a proposition to Governor William Spry and the Trustees of the Utah Agriculture College offering to supply electricity for lamps and motors for the college. The trustees are contemplating installing an electric plant at the college and the company claims it can furnish the service for less than it would cost to install a plant.

BELLINGHAM, WASH.—Notice of appropriation of additional water rights on Lake Whatcom has been filed by W. R. Hill. He also asks for permission to construct a dam at the outlet of the lake.

CHEHALIS, WASH.—The Twin City Light & Traction Company is reported to have awarded the contract for grading the proposed electric railway from Chehalis to Centralia to A. J. McCabe, of Portland, Ore.

MONTESANO, WASH.—Plans are being prepared for the construction of an electric light plant for the Montesano Planing Company, to

cost about $10,000. Bids for the construction of the plant will be asked for in about 30 days. A. Foss is president and manager of the company.

OTHELLO, WASH.—The R. S. King Company, of Seattle, is reported to have purchased the townsite of Othello from the Chicago, Milwaukee & Puget Sound Railway Company. The new owners propose to make improvements to the settlement, including the installation of an electric lighting plant.

PORT TOWNSEND, WASH.—The Irondale Steel Company is reported to have placed contracts for two open-hearth furnaces. Additional equipment, including electric motors, it is said, will be purchased later. The company is also contemplating the installation of a gas engine and generator.

TACOMA, WASH.—The Commissioner of Public Works has recommended to the Council the purchase of another carload of copper wire for use in connection with the municipal electric lighting system.

TACOMA, WASH.—Plans are being considered by the Union Mill Company, of Tacoma, Wash., for rebuilding its lumber mill located on the Northern Pacific spur, this side of Olympia. The work will be done by day labor under the supervision of George C. Moore. The mill will cost about $150,000 and will be equipped for electric motor drive. The apparatus will be installed by the Allis-Chalmers Company, of Milwaukee, Wis.

GREAT CAPACON, W. VA.—We are informed that the Hydro-Electric Developing Company will receive bids for the construction of its proposed plant at Fort Edes, on the Great Capacon River, about March 1, 1910. The proposed plant will cost about $60,000, and will develop about 3000 hp. For further information address Samuel R. Boyer, secretary, 2643 South Third Street, Steelton, Pa.

WHEELING, W. VA.—The City & Elm Grove Railroad Company is contemplating making improvements to its water works system, at a cost of $50,000, to supply its patrons along the National Road, east of Wheeling. The new pumping station will be operated by electricity and will be located in the vicinity of Fulton instead of Elm Grove, where the present station is located.

HATFIELD, WIS.—It is reported that it is proposed to erect another dam in Hatfield above the present one, to cost about $100,000. The proposed dam will have a head of 32 ft., creating a lake about seven miles in length.

MADISON, WIS.—The contract for additional electric fixtures in the east wing of the new state capitol has been awarded to Mitchell, Vance & Company, of New York, N. Y., for $9,000, by the executive committee of the State Capitol Commission.

MARINETTE, WIS.—The Northern Hydro-Electric Company is contemplating the erection of transmission lines to the towns of Green Bay, De Pere and Manitowoc from its hydroelectric power plant at High Falls, on the Peshito River. If the output of the plant is not consumed in these places the transmission line will be extended to Oshkosh, Wis. Work on the constructon of the line, it is stated, will commence in the near future. The plant at High Falls has an output of 7000 hp and the plant at Johnson Falls generates 4000 hp.

WINNECONNE, WIS.—Local business men are contemplating the construction of an electric railway to Oshkosh, Wis., to be extended later to Waupaca.

DOMINION, C. B., CAN.—An agreement has been made between the Corporation of Dominion and the Sydney & Glace Bay Railway Company, of Sydney, whereby the railway company agrees to furnish electricity delivered at the town line at the rate of seven cents per kw-hour, for a term of five years. Arrangements have been made with the railway company and the telephone companies for the privilege of erecting transmission lines for the distribution of electricity on the poles of the companies. It is said that the town proposes to install about 650 incandescent electric lamps for domestic and commercial lighting and 52 incandescent lamps of 32 cp for street lighting.

NEW WESTMINSTER, B. C., CAN.—The British Columbia Electric Railway Company has awarded the contract for the construction of five substations, to be erected along its extension from New Westminster to Chilliwack, to T. R. Nickson & Company.

REVELSTOKE, B. C., CAN.—At an election held recently the citizens voted in favor of the by-law to issue $89,000, for enlarging and improving the municipal electric light plant.

BRIDGEBURG, ONT., CAN.—The Canadian Niagara Power Company, of Niagara Falls, Ont., has applied to the Village Council for a franchise in Bridgeburg.

ST. THOMAS, ONT., CAN.—The Council is contemplating making improvements to the street railway system, which will involve an expenditure of about $10,000. The ratepayers will be asked to vote on the proposition in January.

STRATFORD, ONT., CAN.—A by-law has been passed by the City Council authorizing execution of an agreement with the Stratford Gas Company referring to arbitration of three electrical experts the amount to be paid by the city for the company's electric lighting plant and equipment. After the price has been decided upon, the question will have to be submitted to a vote of the ratepayers as to whether the city will purchase the plant on the terms of the award decided upon.

TORONTO, ONT., CAN.—The Board of Contral has awarded the contract for the motors in connection with the pumping equipment for the main and high-level pumping stations to the Canadian Westinghouse Company for $107,000. The contract for the pumps will be awarded later.

TRENTON, ONT., CAN.—The ratepayers will vote, on Nov. 15, on a by-law passed by the Council authorizing the execution of an agreement between the corporation and the Trenton Electric & Water Company whereby the corporation transfers certain rights in a water lease from the Dominion Government at Dam No. 2 on the Trent River to the company; in return for which the company agrees to furnish electricity to consumers within the limits of Trenton at the following prices: For 1 hp to 15 hp $20 per hp per year; from 15 to 100 hp $17 per hp per year, and all over 100 hp $16 per hp per year, for a 24-hour service based upon the maximum demand for the year. The lease from the government is for 21 years and renewable.

WALKERVILLE, ONT., CAN.—The Walkerville Light & Power Company has been incorporated by Hiram Walker & Sons for the purpose of taking over the local electric light plant heretofore operated by the firm.

HULL, QUE., CAN.—The Hull Electric Company has made arrangements with the Ottawa Electric Company, of Ottawa, under which the last-named company will furnish electricity to operate the system of the Hull Electric Company, while the company is rebuilding its power house, located on Lake Deschenes, which was partially destroyed by fire on Oct. 18.

QUEBEC, QUE., CAN.—Plans are being considered by the Quebec Railway, Light & Power Company for the construction of a substation in St. Anne de Beaupré, Que., contracts for which will probably be placed this year. The company has recently purchased a 500-kw motor generator set from the Canadian General Electric Company.

DUBLAN, MEX.—Plans are being considered by the Hidalgo Cement Company for the construction of a large hydroelectric plant on the Montezuma River, located about three miles from Dublan. The cost of the construction of the dam is estimated at $500,000 and the power plant and electric equipment an additional $200,000. The plant will have an output of 1200 hp. which will be utilized to operate the cement works of the company in Dublan and also furnish electricity for lamps in Dublan.

MEXICO CITY, MEX.—The syndicate of Montreal and Toronto capitalists recently awarded a contract for the construction of a large dam across the Conchos River in the State of Chihuahua for the purpose of furnishing power for a large hydroelectric power plant. A separate company has been formed to carry out the project, which will be known as the Compania de Fuerza Electrica. The contract was awarded to S. Pearson & Son, Ltd., and will cost about $7,500,000 in gold, and includes the construction of a system of irrigation canals and ditches, which will be operated in connection with the electrical project. The hydroelectric plant will develop about 25,000 hp, which will be transmitted to towns and mining camps within a radius of 200 miles. The dam will be over 200 ft. high and will form a reservoir having a capacity of 1,840,000,000 cu. m. of water.

New Industrial Companies.

THE ALDRICH CONTRACTING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 for the purpose of doing a general contracting and engineering business. The incorporators are: A. Bennett Aldrich, Elinor M. Kalstad, of New York, N. Y., and E. A. Whitman, of Jamaica, N. Y.

THE AMERICAN ELECTRIC MACHINE & ELEVATOR COMPANY, of St. Louis, Mo., has made application for articles of incorporation. The company proposes to manufacture and deal in elevators. The capital stock is placed at $10,000. The incorporators are John T. Burke, William A. Krauss and John W. Fierce.

THE BURTON ELECTRIC CLOTH TREATING COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000 for the purpose of dealing in patent electric machinery. G. D. Burton, of Boston, Mass., is president of the company, and L. Harris, of Jamaica Plain, Mass., treasurer.

THE CENTRAL WIRELESS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,000 by James R. McLean, Orley Granger, of New York, N. Y., and Richard E. Nebel, of Brooklyn, N. Y. The company proposes to manufacture telephone and telegraph devices and appliances; also electric and mechanical apparatus.

THE COLT-STRATTON COMPANY, of New York, N. Y., has been chartered with a capital stock of $125,000 by W. L. Colt, H. L. Stratton and S. H. Veal, of New York, N. Y. The company proposes to manufacture motors, engines, machines, etc.

THE CUSHNOE MOTOR COMPANY, of Augusta, Maine, has filed articles of incorporation with a capital stock of $100,000. The purpose of the company is to manufacture all kinds of engines. The incorporators are: C. B. Burleigh, W. J. Skehan and L. A. Burleigh, of Augusta, Maine.

THE DOUGLASS ENGINE & MANUFACTURING COMPANY, of Birmingham, Ala., has filed articles of incorporation with a capital stock of $15,000 for the purpose of manufacturing engines. The officers are: R. H. Hamrick, president; C. P. McCurry, vice-president; J. S. Kennedy, secretary and treasurer, and J. E. Douglass, general manager.

THE DUPLEX VACUUM ENGINE COMPANY, of Chicago, Ill., has been incorporated by L. Kessler, J. Reckinger and A. L. Luessenhop, of Chicago, Ill. The company is capitalized at $30,000 and proposes to manufacture and sell mechanical devices.

THE FISH SYSTEM COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $50,000 by George L. Fish, R. C. Davis, H. F. Huster and E. A. Leeson. The company proposes to manufacture and sell electrical and power apparatus and supplies.

THE FORT WAYNE ELECTRIC SUPPLY & FIXTURE COMPANY, of Fort Wayne, Ind., has been incorporated with a capital stock of $25,000 by S. M. Foster, F. H. McCulloch and H. L. Taylor. Mr. McCulloch will be manager of the company and will have offices in the Minuet Building, East Washington Street, Fort Wayne, Ind.

THE GARBUTT MACHINE & FOUNDRY COMPANY, of Ogdensburg, N. Y., has been incorporated by Max A. Jameson, Myron E. Gray, William O. Ingram, all of Ogdensburg, N. Y. The company is capitalized at $10,000 and proposes to do an electrical and mechanical engineering and mechanical business.

THE GLEESON-BROKAW ELECTRIC COMPANY, of St. Louis, Mo., has made application for articles of incorporation, with a capital stock of $2,000. The object of the corporation is to manufacture and deal in electrical fixtures. The incorporators are: Thomas P. Gleeson, Paul V. D. Brokaw and Linn R. Brokaw.

THE GREENWOOD ENGINEERING & CONSTRUCTION COMPANY, of Dover, Del., has been chartered with a capital stock of $50,000 by E. H. Greenwood, of Camp Hill, Pa.; J. R. Barber and R. W. Dunlop, of Harrisburg, Pa. The company proposes to do a general engineering business.

THE HAWHURST WIND TURBINE POWER COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $200,000 by the following directors: H. I. Hawhurst, George Humphries and T. M. Webster. The company proposes to manufacture wind turbines. It is said that the company has taken an option on a site and building where it proposes to install a plant.

THE MOTOR & MACHINE COMPANY, of Red Springs, N. C., has been chartered with a capital stock of $25,000 by James A. Lane, W. E. Garrett and L. M. Cook. The company proposes to manufacture motors and machines.

THE MOTOR PARTS COMPANY, of West Orange, N. J., has been incorporated with a capital stock of $125,000 to manufacture motors, engines, machines, etc. The incorporators are: W. D. Sargent, West Orange, N. J.; G. M. Judd and E. H. Fallows, of New York, N. Y.

THE NEWPORT BATTERY COMPANY, of Newport, Wash., has been organized with a capital stock of $7,000 for the purpose of manufacturing dry cell batteries, gasoline engines and auto battery sets. R. S. Anderson is interested in the project.

THE NORTHEAST ELECTRIC COMPANY, of Rochester, N. Y., has been chartered with a capital stock of $125,000 for the purpose of doing electrical work. The incorporators are: E. A. Halbleib, J. J. Stafford, of Rochester, N. Y., and J. C. Halbleib, of Cleveland, Ohio.

THE ODIN DRY BATTERY COMPANY, of New York, N. Y., has been chartered with a capital stock of $25,000. The company will do general electrical engineering work and also manufacture electrical supplies. The incorporators are: Benjamin Colby, Harry C. Adams and H. R. Berlincke, all of New York, N. Y.

THE STATE ELECTRIC CONSUMERS' LEAGUE, of New York, N. Y., has filed articles of incorporation, with a capital stock of $500. The incorporators are Howard H. Sherrard, Walter L. Dreyfus and George J. Schroeder, all of New York, N. Y. The purpose of the league is to inspect and audit charges of heating, electric, gas and power companies, and to examine wires, pipes and conduits.

THE SUBURBAN MOTOR TRANSIT COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $100,000 by J. A. McClary, of Rahway, N. J.; G. L. Burton, of New Brunswick, N. J., and T. J. Gantly, of Jersey City, N. J.

THE TAIT PRODUCER COMPANY, of Montclair, N. J., has been incorporated with a capital stock of $100,000 by E. Benjamin, L. M. Takacs, of Newark, N. J., and F. Benjamin, of East Orange, N. J. The company proposes to manufacture and deal in gas power engines and gas producer engines.

THE UNIVERSAL HARTEL LIGHT COMPANY, of Dover, Del., has filed articles of incorporation with a capital stock of $100,000. The company proposes to exploit Hartel light patents. The incorporators are: J. F. Alee, J. F. Alee, Jr., of Dover, Del., and E. B. Davis, of Wilmington, Del.

THE UNIVERSAL TIRE PROTECTOR COMPANY, of Angolia, Ind., has incorporated to establish and equip a factory for the manufacture of certain automobile accessories known as the "Universal" adjustable full tread and the "Universal" emergency tire sleeve; also for the manufacture of other accessories, electric supplies, etc. The capital stock is placed at $30,000. Samuel C. Wolf, F. S. Croxton, James R. Nyce and W. W. Love are directors.

THE WILLIAM H. KING COMPANY, of Newark, N. J., has been incorporated by William H. King, William T. Leary and Alice A. King, of Newark, N. J. The company is capitalized at $50,000 and proposes to manufacture boilers, hardware, machine specialties, etc.

New Incorporations.

HELENA, ARK.—The Interurban Railway Company has been chartered, with a capital stock of $10,000, for the purpose of constructing a street car and interurban railway in Helena; also operating a railway from Helena to a new addition to the city. The incorporators are: E. C. Horner, John S. Horner and C. H. Purvis.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Highland Pacific Railroad Company for the purpose of constructing an electric railway from Lakeport to Clear Lake. The company is capitalized at $2,500,000, and the directors are: J. E. Fulton, D. F. McIntyre, J. R. Garner, W. P. Mariner and A. E. Dickinson. J. R. Garner is treasurer. The main office of the company is in San Francisco.

BOISE, IDAHO.—Articles of incorporation have been filed for the Gooding, Soldier & Boise Interurban Railway Company for the purpose of constructing a railway to be operated by steam or electricity to connect Boise and Gooding with the Idaho Southern into the Twin Falls country. The company is capitalized at $1,000,000.

OKAWVILLE, ILL.—The Okawville & Southern Telephone Company has been chartered, with a capital stock of $2,000, by Herman H. Brockmeier, William Grewe and William Randall.

VERGAS, MINN.—Articles of incorporation have been filed for the Vergas Telephone Company, with a capital stock of $10,000. The officers of the company are: W. B. Carman, of Detroit, Minn., president; James Nesbitt, of Vergas, secretary, and A. G. Schwarzrock, of Vergas, treasurer.

TEGARDEN, IND.—The St. Joe County Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $1,000 and proposes to build and operate a telephone exchange and system in Tegarden and St. Joe County. The directors are, W. C. Divine, C. F. Ruple, J. S. Davis and Frank Retter.

THURMONT, MD.—Articles of incorporation have been filed for the Citizens' Electric Light & Power Company by John R. Rouzer, Morris A. Birely, Martin L. Creager and others. The company is capitalized at $15,000 and proposes to establish a hydroelectric power plant to furnish electricity for lighting the streets and residences of the town.

BUTTE, MONT.—Articles of incorporation have been filed for the Inter-State Consolidated Telephone Company in Butte, Mont. The company is capitalized at $5,000,000 and has already acquired the Home Telephone Company, of Spokane, Wash. The company will operate in the Northwest, taking over the Independent Telephone Company of Montana. The corporation is backed by San Francisco, Los Angeles, Spokane, Portland, Butte and Missoula capitalists.

BYRON, MO.—The Byron Water Power Company has been incorporated with a capital stock of $1,000 by George M. Clark, Allen W. Hetrick and George F. Bunn.

ST. JOSEPH, MO.—The St. Joseph Long Distance Telephone Company has been formed, with a capital stock of $1,250,000, by Theodore Geary, of Macon, Mo.; Walter S. Dickey, of Kansas City, Mo.; W. F. Rankin, of Tarkio, Mo.; G. H. Davis, of Kansas City, Mo., and R. W. Frey, of St. Joseph, Mo. The company proposes to absorb, it is said, a large number of independent telephone systems in northwest Missouri.

ST. LOUIS, MO.—Articles of incorporation have been filed for the St. Louis-Kansas City Electric Railway Company for the purpose of constructing an electric railway to connect St. Louis and Kansas City, Mo., with a branch from Glasgow, through Charitor to Brookfield. The railway will be 295 miles in length and will be capitalized at $5,000,000. The directors are: D. C. Nevins, Charles A. Loomis, of Kansas City, Mo.; H. V. Johnson, W. Weston and B. L. Dorsey, of Denver, Colo.; W. A. Hamilton, of Chicago, Ill.; L. M. Nevins, Seldon P. Spencer, of St. Louis, Mo., and others

VINELAND, N. J.—The Northern New York Construction Company has been organized to construct an electric railway extending from Vineland to Bridgeton. George E. Stevenson is president of the company; B. F. Patterson, of New York, N. Y., and Frank Parvin, vice-presidents; T. H. Coggey, of New York, N. Y., secretary, and H. C. Bartlett, treasurer. Surveys are now being made for the railway.

CATTARAUGUS, N. Y.—The Cattaraugus Union Telephone Company has been incorporated, with a capital stock of $50,000, to operate in the counties of Niagara, Erie, Chautauqua, Cattaraugus, Orleans, Genesee, Wyoming, Allegany, Livingston, Steuben and Monroe. The directors are: Charles M. Beattie, William T. Farrell and W. Roy McCanne.

NASHVILLE, N. C.—The Nashville & Castalia Telephone Company has been organized for the purpose of erecting a telephone line between Nashville and Castalia. S. J. Bartholomew is president of the company, and S. F. Austin, secretary and treasurer.

DOUGHERTY, OKLA.—The Arbuckle Water Power Electric Company has been chartered, with a capital stock of $10,000, by W. T. Croslen, of Chickasha, Okla.; W. F. McCormick, W. J. Williams, of Sulphur, Okla., and S. A. Newland, of Ardmore, Okla.

PHILIPSBURG, PA.—The Philipsburg & Susquehanna Valley Railroad Company has been chartered to take over the properties of the Philipsburg Railroad Company, the Center & Clearfield Street Railway Company, the New Steam Company and the Philipsburg Electric Light, Gas, Power & Heating Company. A bond issue of $2,000,000 has been

authorized. The officers of the company are: Thomas F. Barrett, of New York, N. Y., president; Charles H. Rowland, of Philipsburg, vice-president; W. W. Cole, second vice-president and electrical engineer; Howard M. Van Court, of Philadelphia, Pa., treasurer; George W. Zeigler, secretary, and J. O. Reed, general manager.

ROCK HILL, S. C.—The Carolina Traction Company has been granted a charter with an initial capital stock of $150,000 and ultimate capital of $500,000 for the purpose of establishing a rural car system radiating from Rock Hill, taking in Charlotte, Chester and Yorkville, and to tap the seaboard in Yorkville County. The incorporators are: J. M. Cherry, of Rock Hill; W. S. Lee and George Stevens, of Charlotte, N. C. The charter of the company gives it power to lease and build power plants, own and operate gas and lighting plants, also telephone and telegraph lines.

MEMPHIS, TENN.—The Tennessee Traction Company has been incorporated, with a capital stock of $50,000, for the purpose of constructing a traction line between Memphis and Nashville, Tenn. George E. Bushnell, consulting engineer, of Indianapolis, Ind., is interested in the project.

SALT LAKE CITY, UTAH.—The Meteor Electric Company has been incorporated, with a capital stock of $10,000, and the following named officers: L. E. Bedford, president; J. J. Campbell, vice-president; L. D. Gordon, secretary and treasurer; J. C. Cumo and E. J. Kingsley are directors.

SPOKANE, WASH.—The Mattawa Power & Irrigation Company has been chartered with a capital stock of $500,000 by Edward Campbell, E. L. Campbell and William J. Sanderson.

SPOKANE, WASH.—The Columbia River & Mt. Adams Railroad Company has been incorporated with a capital stock of $2,000,000 to construct an electric railway from some point on the Columbia River in Klickitat County through parts of Klickitat, Yakima and Skomania counties to a point in the vicinity of Mt. Adams. The company also proposes to operate steamboats on the Columbia River and to furnish electricity for lamps and motors. The trustees of the company are: Adolph H. Suksdorf, Edward H. Suksdorf and Oswald N. Suksdorf, all of Spokane, Wash.

Personal.

MR. OSCAR T. CROSBY is being prominently mentioned among those who are being considered by President Taft for appointment as Minister to China.

MR. E. J. DEUTH, formerly assistant manager of the tungsten department of the German-American Electric Company, has been appointed manager of that company.

MR. W. H. FELLOWS, superintendent of the Leavenworth Light & Heating Company, of Leavenworth, Kan., is visiting Eastern cities on a business trip. On Nov. 3 he was a guest at the meeting of the Electric Club in Chicago.

MR. W. S. DIX, who was formerly connected with R. Thomas & Sons Company, and later engaged in hydraulic developments on the Pacific coast, has returned to New York. Mr. Dix has made no definite plans for the immediate future.

MR. HARVEY N. SMITH, for a number of years connected with the Wheeler-Green Electric Company, of Rochester and Syracuse, is now engaged in general electrical engineering and contracting under the name of the Conduit Electric Company, Syracuse, N. Y.

MR. J. STEWART THOMSON, formerly vice-president and treasurer of the New York Safety Steam Power Company, has associated himself with the Harrison Engineering Company, to develop the Harrison air-tube system of heating and ventilating, with offices at 42 East Twenty-third Street, New York.

MR. CHARLES P. HIDDEN has become associated with Rosenbaum & Stockbridge, patent attorneys, New York. Mr. Hidden, who is a graduate in mechanical and electrical engineering, has until recently been an examiner in the United States Patent Office, and has also qualified for the practice of patent law.

MR. EDWARD BENNETT, of Jeanette, Pa., recently appointed associate professor of electrical engineering of the University of Wisconsin, has begun his work. Professor Bennett, who has been located at Telluride Institute at Ohmstead, Utah, was graduated from Western University of Pennsylvania, now the University of Pittsburgh, several years ago with the degree of electrical engineer.

MR. E. A. LOF has resigned as head of the commercial switchboard department of the Western Electric Company to accept a position in the power and mining engineering department of the General Electric Company, at Schenectady. Mr. Lof had been connected with the power apparatus engineering department of the Western Electric Company for six years or more, latterly as head of the switchboard branch.

DR. ERNST J. BERG, consulting engineer of the General Electric Company, Schenectady, has been appointed professor of electrical engineering in the University of Illinois, at Urbana, Ill. Dr. Berg graduated from the Royal Polytechnic Institute of Stockholm in 1892, and came to the United States a year later. He has been associated with the General Electric for 17 years. In the last three years he has been a special lecturer at the Union University, Schenectady. Dr. Berg succeeds, as head of the department of electrical engineering, Professor Morgan Brooks, who is now absent on leave for foreign study. It is announced, however, that the coming of Dr. Berg will not deprive the university of the services of Professor Brooks, who, at the expiration of his leave, will continue as a professor in the department.

MR. LOUIS C. FRITCH, consulting engineer of the Illinois Central Railroad, has resigned to become chief engineer of the Chicago Great Western Railway, the new appointment to be effective Nov. 15. Mr. Fritch, who was formerly assistant to President Harahan, of the Illinois Central, has been the company's electrification expert for several years, and as such has been much in the public eye. As the directors have decided to make no immediate use of his plans for electrification, the scope of his work has been diminished. Mr. Fritch is vice-president of the American Railway Engineering and Maintenance of Way Association and is chairman of that association's committee on electrification.

MR. ARTHUR J. SWEET will leave the Westinghouse Lamp Company on Dec. 1 to join the engineering department of the Holophane Company. In his new position Mr. Sweet will have charge of important new development work which the Holophane Company has long planned to undertake. Mr. Sweet is a graduate of Cornell and also completed three of the four years' course in electrical engineering at Massachusetts Institute of Technology. After a shop apprenticeship course he spent three years with the Westinghouse Electric & Manufacturing Company, nine months with the Western Electric Company and about two years and a half with the Westinghouse Lamp Company. His work throughout has been along lines of practical and theoretical development. In the lamp works he gained an intimate knowledge of photometric methods and equipment and did considerable work in illumination design.

Obituary.

MR. PAUL SHEEHAN, a well-known telegrapher and one of the night chiefs in the Western Union Telegraph office at 195 Broadway, New York, died at his home in Brooklyn, Nov. 2, after an illness of several months. He had been in the Western Union Company's service for nearly 40 years. He is survived by a widow and four children.

MR. ARTHUR H. EDWARDS, general purchasing agent and storekeeper for the Montreal Light, Heat & Power Company, died on Oct. 28. Mr. Edwards suffered four years ago from a severe illness with complications of the heart, and eight weeks ago the trouble recurred, resulting in his death. He was 38 years of age, and left a widow but no children.

MR. W. W. CARGILL, a prominent business man of La Crosse, Wis., and identified with several electrical enterprises, died on Oct. 17. Mr. Cargill was vice-president of the La Crosse City Railway Company and a heavy stockholder in the La Crosse Gas & Electric Company. He was also president of the Vote-Berger Company, which manufactures telephone apparatus, and prominent in the affairs of the La Crosse Telephone Company.

MR. GEORGE F. DURANT, general manager of the Bell Telephone Company of Missouri, which he founded in 1878, died Oct. 31, at the Boulder Sanatarium, in Boulder, Col. His death was unexpected. Heart failure is given as the immediate cause of death. He suffered a sunstroke last summer in St. Louis, but never fully recovered from the stroke and his health declined rapidly until October, when he went to Boulder. His body was cremated and was brought to St. Louis by Mrs. Durant. Mr. Durant installed the first telephone exchange in St. Louis in 1878. When this pioneer company was absorbed by the Bell Company, he became general manager of the Bell, and was also a director of the corporation. He had been a director in the Lincoln Trust Company and was also the vice-president of the Lakeside Sugar Refining Company. Mr. Durant was born in Jersey City, N. J., March 26, 1842, and was educated in the New Jersey private schools. He married twice, first, Mrs. Alice Smith, of Moriches, N. Y., and second, Miss Annie Fell, of Bloomington, Ill. He began his business career by learning the printer's trade. During the civil war he became a telegrapher on the Union side and was in the battle of Gettysburg. In 1870 he became superintendent of fire-alarm telegraph at Jersey City, N. J. Four years later he came West to St. Louis and installed the District Telegraph. In 1878 he installed the first telephone exchange and largely to his management the present company owes its efficient service. At the start the company was a very small institution, and as a business venture did not attract capital. With rare skill at organization, he began the work of extending the lines of the company. At the time of his death he was working upon plans for additional extensions, particularly in the West. He intrusted little of his work to subordinates, and was perfectly informed even in minor mechanical details of the operation of a telephone system.

Trade Publications.

SUCTION SWEEPERS, of the electric motor-driven type, are briefly outlined and illustrated on a calendar card of the Electric Suction Sweeper Company, New Berlin, Ohio.

COPPER-CLAD STEEL WIRE, for trolley circuits where tensile strength is of importance, is illustrated in a folder of the Duplex Metals Company, 149 Broadway, N. Y.

MINIATURE ELECTRIC RAILWAYS.—The Central Electric Company, Chicago, Ill., has issued a 16-page catalog devoted to a description of miniature electric railways suitable for electrical gifts at Christmas.

VEHICLE BATTERIES.—The Electric Storage Battery Company, Alleghany Avenue and Nineteenth Street, Philadelphia, has issued bulletin No. 116, containing a paper by Mr. H. M. Beck, on the care and operation of vehicle batteries.

RHEOSTATS FOR PLATING.—The Ward Leonard Electric Company devotes several sections of its new perpetual catalog to rheostats for the control of plating generators, of which diagrams and descriptions are given with potentiometer connections.

GAS ENGINES.—Bulletin K-21 of the Du Bois Iron Works, Du Bois, Pa., contains a detailed description of single-cylinder throttling gas engines rated at from 5 hp to 100 hp. These engines are well adapted for use in small industrial and private lighting plants.

WIRING CONDUIT.—The National Metal Molding Company, Pittsburgh, Pa., is distributing folders for calling attention to its "Sherarduct" conduit. This conduit is a mild steel pipe, both the inside and outside of which contain coatings of alloyed zinc and iron.

INDUCTION MOTORS of the polyphase constant-speed type rated at from 0.25 hp to 250 hp are fully described in bulletin No. 115 of the Crocker-Wheeler Company, Ampere, N. J. Descriptions are also given of starting devices, including star-delta switches and auto-transformers.

GAS PRODUCERS for bituminous fuels are well discussed in circular W.M. 503 of the Westinghouse Machine Company, East Pittsburgh, Pa. It is claimed that with Pocahontas coal averaging 13,983 thermal units per lb. a consumption as low as 0.996 lb. per brake hp-hour has been obtained under test conditions.

STATIONARY TRANSFORMERS of the oil-insulated self-cooled type are well illustrated and described in an instructive manner by the Pittsburg Transformer Company, Pittsburgh, Pa. The coils in these transformers are wound directly upon the laminated core of silicon steel. The transformers are built in ratings up to 500 kw.

ARC LAMPS.—The General Electric Company has issued bulletin No. 4676 illustrating and describing various types of enclosed arc lamps for use on direct-current and alternating-current circuits for interior illumination. The publication includes a description of the use of these lamps for blue printing work. It contains also illustrations and descriptions of lamp hanger boards, globes and reflectors.

METER TESTING.—The Central Electric Company, Chicago, Ill., has issued a 16-page circular entitled "Economical Meter Tests Made with P-M Meter Connection Blocks." This publication gives full directions for testing all types of meters by means of the new P-M system. It is claimed that the adoption of this system will reduce meter testing expense from 15 to 40 per cent, and will absolutely prevent theft of current.

ORGAN REGULATORS.—The Ward Leonard Electric Company devotes section D-12 of its new perpetual catalogue to organ regulators. These regulators are a new design, a special feature of which is that a customer can order an organ regulator by simply stating the horse-power and voltage of the motor driving the bellows. There is sufficient resistance in the rheostat to give 50 per cent speed control under full load conditions and to stop the motor under practically no load conditions.

ELECTRIC VEHICLES.—The General Vehicle Company, Long Island City, N. Y., has issued some instructive and convincing publications relating to electric vehicles and their advantages from a business point of view. A neatly executed general catalog gives views of numerous electric vehicles built for industrial service. The various types of vehicles are described in detail in service bulletin No. 1, while the business features of the electric vehicle for trucking and delivery service are outlined in a special booklet.

SEVENTY-FIVE YEARS OF ENGINE BUILDING is the title of a handsome publication just issued by the C. & G. Cooper Company, of Mount Vernon, Ohio. A large proportion of the book is devoted to a historical account, describing the humble beginnings of the original foundry of Charles and Elias Cooper in 1833. There is a chapter descriptive of the company's works, their location and facilities, and the various classes of engines they are capable of producing. The booklet is profusely illustrated, the effect of the decorative scheme being to convey to the reader an impression of the progress which has characterized these 75 years of engine building.

STORAGE BATTERIES.—The increasing demand during the past few years for electric lighting and power plants in factories, institutions, residences, etc., where service from central lighting stations is not available has led to the installation of many isolated generating plants operated by gas or gasoline engines in connection with storage batteries. The development of the high economy metallic filament lamp has materially broadened this field of electric lighting and the storage battery has become a standard part of an installation of this kind. The Electric Storage Battery Company, of Philadelphia, has issued two publications, which cover the requirements for this service, in the form of illustrated booklets containing details of installation and the switchboard and generator requirements with prices covering complete equipments of battery and switchboard. These publications are entitled Hand-books IP and LV.

PORTABLE SUBSTATIONS.—The General Electric Company has designed and developed portable substations consisting of specially arranged cars containing complete substation equipments including a rotary converter or motor-generator set of the required capacity, transformers, switchboards and accessories, to provide for a temporary supply of energy. These substations are equipped with trucks adapted for short radius curves, and may be conveniently moved to any section of the road requiring energy temporarily. Connections to the high-tension lines and direct trolley or feeders are all that is necessary to render the portable station ready for immediate service. An interesting bulletin on this subject has just been issued by the General Electric Company as No. 4694. This bulletin contains a plan and elevation of a portable substation and other illustrations, both interior and exterior.

Business Notes.

MESSRS. BENNETTS & KEEGAN are entering upon the electrical contracting business in Cheyenne, Wy.

THE DI-EL-ITE MANUFACTURING COMPANY, of Philadelphia, has opened a New York office at 120 Liberty Street, to be in charge of Mr. G. R. Hall, secretary and treasurer of the company.

THE APPLETON ELECTRIC COMPANY has recently moved into larger quarters at 25 West Broadway, New York, where it carries a complete line of unilets, outlet boxes, fixture studs, locknuts and bushings.

THE DUPLEX METALS COMPANY has taken offices on the thirty-second floor of the Singer Building, 149 Broadway, New York. The offices of the company have been on a lower floor of the same building since last May.

THE W. MONTELIUS PRICE COMPANY has moved from 525 New York Block, Seattle, Wash., to 524 First Avenue, S., same city. The firm represents a number of prominent manufacturers of electrical apparatus and supplies.

EDWARD E. CARY COMPANY, importer of electrical specialties, 59-61 Park Place, New York, reports a considerable demand for enameled steel reflectors for tungsten lighting. Among other large contracts it is supplying the domes and deflectors for the parks of New York City, for the tungsten lamp posts.

PANEL BOARDS.—Bulletin No. 4681 of the General Electric Company, illustrates and lists all of the panel boards designed by this company. The line of boards includes designs selected after careful study of all general requirements. The bulletin will be of service to architects, builders and jobbers in general.

GARWOOD ELECTRIC COMPANY.—The Garwood Electric Company, which is the successor to the C. & C. Electric Company, reports that its business is now first-class. It has recently installed in New York in the Ritz-Carlton Hotel and the new Hotel Martinique, thorough systems for ventilation and heating. This ventilating business is one of the chief features of the Garwood Company.

ANGLE-COMPOUND ENGINES.—As evidence of the satisfaction that Angle-Compound high-speed engines are giving, the American Engine Company, of Bound Brook, N. J., report orders for two 500-hp Angle-Compound engines to be used for running centrifugal pumps of the Interborough Rapid Transit Company power plants. This order is the result of the good performance of similar engines installed earlier in the season. Bloomingdale Brothers have installed a 400-hp engine of the same type, and the three lighting units installed in the Belnord Apartments are now in continuous operation.

THE CARB-OX COMPANY, of Rogers Park, Ill., a suburb of Chicago, has been formed to take over the patents and business of Joseph W. Hayes, of Chicago, who has for several years been developing and selling a line of apparatus for use in studying the composition of boiler-flue gases. Mr. Hayes has made a specialty of furnace and flue-gas engineering for several years. The new company will make gas analysis instruments of all kinds, including CO_2 detectors, gas-sampling apparatus, damper regulators and automatic indicating and recording gas calorimeters, which will indicate continuously the thermal units per cubic foot. This is a class of apparatus for which there is a rapidly increasing demand, owing to the deserved attention which the question of furnace efficiency is receiving.

WESTINGHOUSE BALTIMORE SHOW-ROOM.—The Baltimore office of the Westinghouse Electric & Manufacturing Company, as part of a vigorous campaign for business, has established a display room on the principal street of the city, and demonstrations in the window have attracted much attention, the crowds attracted frequently blocking the sidewalk. The demonstrations of the use of electric cooking utensils have been especially appreciated. The window displays are changed twice weekly, and passers-by have become accustomed to stopping to see the latest exhibits. Last week the advantages of Westinghouse tungsten lamps were brought out by means of a meter which was automatically connected for short intervals to banks of carbon and tungsten lamps, and registered for each interval the respective consumptions of energy. The passer-by noted that with a larger candle-power in tungstens the consumption was half that of carbon-filament lamps.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 2, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

938,471. GROUNDING DEVICE OF TERMINAL FOR LINE-WIRES; William R. Garton, Brooklyn, N. Y. App. filed Nov. 12, 1908. Consists of a terminal of hydro-scopic material and non-hydro-scopic material made up in units with a metal rod extending through them.

938,477. FUSE HOLDER; J. E. Graybill, York, Pa. App. filed July 5, 1904. A fuse block consisting of a block with a recess, a terminal thereon, the terminal having collapsible walls enclosing the socket and a washer enclosing the walls.

938,501. ADDING MACHINE; F. R. McBerty, Evanston, Ill. App. filed Feb. 27, 1904. Electric means for operating adding machines, in which a motor circuit with a motor operates the driving member, the circuit being closed by a hand-operated switch and a magnetic switch.

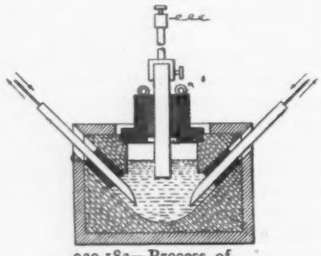
938,541. TELEPHONE EXCHANGE SYSTEM; C. L. Zahm, Los Angeles, Cal. App. filed Sept. 19, 1905. Subscribers working on an automatic system can trunk directly into a manual system by a selector switch controlled by a subscriber's line and a manually operated switchboard, the switch first displaying a signal, thus indicating when a connection is desired on the switchboard.

938,553. PRIMING CHARGE FOR MINES; Louis Cahuc, Neumarket, Germany. App. filed June 15, 1908. Aluminum powder in a state of fine division lies between the bared portions of the wires.

938,558. DYNAMO-ELECTRIC MACHINE; A. L. Cushman, Concord, N. H. App. filed May 27, 1907. Makes use of interpolar or commutating magnets in a magnetic circuit independent of the field magnetic circuit, thus preventing sparking.

938,575. TUBING; E. T. Greenfield, Kiamesha, N. Y. App. filed Oct. 3, 1908. A spirally formed strip of metal to form a series of interlocking convolutions, certain of them being cut or weakened so that they may be broken.

938,553—Priming Charge for Mines.



939,183—Process of Generating Electricity.

938,581. CARBID AND METHOD OF MANUFACTURING SAME; Herman L. Hartenseting, Constantine, Mich. App. filed Feb. 23, 1907. Produces a fused liquid mass of carbid and agitates it while solidifying it.

938,631. WIRELESS CLUSTER; R. B. Benjamin, Chicago, Ill. App. filed June 19, 1907. The supporting base carries conducting plates, an insulating ring is arranged in each opening of the casing and has two diameters, the larger portion being confined between the casing and block and the smaller portion extending outwardly through the casing with a threaded contact in the ring engaging a plate carried by the block.

938,632. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Oct. 28, 1907. An insulating threaded lamp holder in each opening, each lamp holder comprising a ring having two diameters and having its smaller part passed outward through one of the openings of the casing, the larger portion of the ring being held between the casing and the insulating block.

938,634. METALLURGICAL PROCESS; A. G. Betts, Troy, N. Y. App. filed Nov. 30, 1906. Makes aluminum by reducing aluminum ore in the presence of iron to an alloy containing iron and aluminum, adds iron sulphite, reducing the iron, and then decomposes aluminum sulphide electrolytically.

938,635. PANEL BOARD; A. E. Blackman, Mount Vernon, N. Y. App. filed Oct. 15, 1908. Avoids the necessity of keeping the door open to get at the switches by making use of a single set of switches wholly within the compartment and having operating members extending therethrough surrounded by the metal.

938,649. CONTROLLER FOR ELECTRIC MOTORS; F. Diehl, Elizabeth, N. J. App. filed May 11, 1908. The motor frame has a switch-box with fixed and movable contact plugs connected with the branches of the motor circuit and controlled by a lever lying in the path of movement of the clutch operating lever.

938,663. BATTERY CONTACT; J. H. Gugler, Minneapolis, Minn. App. filed Feb. 21, 1908. A battery having an annular well in the bottom containing a body of mercury with which the lead wire connects.

938,664. ELECTRIC SWITCH; G. W. Hart, West Hartford, Conn. App. filed May 5, 1909. Double throw push button switch whereby the actuated member may be moved beyond the end of the stroke without effect, thus avoiding defects in the positioning of the switch.

938,671. RESISTANCE UNIT; H. W. Leonard, Bronxville, N. Y. App. filed Nov. 13, 1905. A reflex ribbon conductor and two protected sheet metal supports, the ribbon being supported edgewise.

938,672. BINDING POST; H. E. Leppert, New Britain, Conn. App. filed April 2, 1908. A binding post with a screw having an enlarged shoulder adapted to clamp a conductor between it and the inside of one of the walls of the stationary member of the post.

938,682. OUTLET BOX; J. T. Meleady, Newark, N. J. App. filed May 20, 1908. An outlet box having a perforation for receiving the conduit, a sleeve thereon embracing the conduit, said sleeve being provided with a radial lug having a slot and inclined face together with a screw and ribs.

938,708. ELECTROMECHANICAL DEVICE; G. H. Rowe, Riverside, Ill. App. filed June 19, 1908. A stamp mill consisting of a magnet and reciprocating armature and a secondary circuit in which current is induced by the slip between the magnet and the armature.

938,709. ELECTROMECHANICAL DEVICE; G. H. Rowe, Berwyn, Ill. App. filed June 11, 1909. A reciprocating drill having a casing, a magnetizing coil, a movable hollow core within the coil, a plunger in the core having a striking part and a motor to reciprocate the core.

938,723. COUPLING FOR FISH TAPES; F. A. Swan, Cliftondale, Mass. App. filed Feb. 19, 1909. Two fish tapes inserted into the conduit from opposite sides are automatically coupled by means of a hollow head on one, which engages a hook on the other.

938,740. ELECTROMAGNETIC DEVICE; E. A. Brofos, Chicago, Ill. App. filed May 23, 1908. Relay for telephone which is uniformly responsive to alternating currents when used as a pilot relay in an alternating current ringing circuit. Uses two electromagnets, one receiving current from the fluctuating source and the other inductively from the former.

938,752. METHOD OF WORKING METALS, ORES AND THE LIKE; O. Frick, Saltsjobaden, Sweden. App. filed Aug. 31, 1905. An electric transformer furnace in which the principal part of the charge in one furnace is conveyed to another adapted to hold a larger charge than the former one.

938,768. METAL MOLDING; P. T. Kenny, New York, N. Y. App. filed Nov. 24, 1908. For conveying electric light wires and serving as a picture molding consisting of a trough-shaped body of sheet metal and a cover therefor.

938,811. BOX; J. H. Baker, Philadelphia, Pa. App. filed April 8, 1909. A terminal fuse or switchbox made up of sides held together by right angular brackets.

938,830. ELECTRICAL APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS; A. T. Dawson and G. T. Buckham, London, Eng. App. filed Nov. 27, 1905. For use on shipboard for transmitting from the conning tower the range and signals for gun crews.

938,865. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed March 18, 1908. A storage battery and generator are used, the booster being in series with the battery. Means are provided for removing the hysteresis effect from the booster.

938,918. POWER GENERATOR; C. C. Tuch, Honolulu, Territory of Hawaii. App. filed July 29, 1907. A series of planetary gears driven from an internal gear to transmit power to a generator.

938,992. TELEPHONE TRANSMITTER; C. E. Egner, of Stockholm, and J. G. Holstrom, Saltsjo-Storangen, Sweden. App. filed Feb. 18, 1909. A telephone transmitter with a diaphragm strained with its center toward the periphery and a disk forming an electrode secured to the diaphragm.

939,006. STORAGE BATTERY; G. M. W. Goettling, Brookline, Mass. App. filed Jan. 4, 1909. For preventing breakage of the insulating plates of glass by using an insulating bar with a recess fitting over the top edge of the plate and having notches to receive and space the glass plates.

939,054. ELECTRIC WATER HEATER; P. P. Meyers, Grinnell, Iowa. App. filed Jan. 2, 1909. Two electrodes are contained within a casing and a number of electrode members are detachably connected with each elctrode, the water flowing around the electrodes.

939,095. ELECTRIC FURNACE; H. Rochling and W. Rodenhauser, Volkingen, Germany. App. filed Sept. 7, 1906. For converting iron into steel in which an electric transformer induces current in the bath. It has a main field and a leakage field and a conductor arranged in the leakage field, with means for leading the current induced therein to the melting channel to heat the material.

939,128. FIRE ALARM; W. Goodchild, New York, N. Y. App. filed March 18, 1909. An electrically actuated fire alarm in which a mercurial thermometer controls the circuit.

939,154. ELECTRIC CONTROLLING AND SIGNALING SYSTEM FOR RAILWAYS; H. E. McDonnell, Leominster, Mass. App. filed Jan. 26, 1907. A third rail co-operates with a contact carried by a switch tongue, thus completing a short circuit and operating controlling mechanism upon the car.

939,183. PROCESS OF GENERATING ELECTRICITY; Henry Spencer, Blackmore, Mount Vernon, N. Y. App. filed April 18, 1903. Exposes a molten electrolyte to the action of a carbide electrode and a more electro-negative elctrode.

939,186. SELECTIVE APPARATUS FOR SYSTEMS OF COMMUNICATION; E. E. Clement, Washington, D. C. App. filed Oct. 11, 1906. For telephone systems in which a less number of relays than the total number of circuits is used, the relays being actuated in order by circuit closers, preferably push buttons.

939,187. METHOD OF SELECTION IN SYSTEMS OF COMMUNICATION; E. E. Clement, Washington, D. C. App. filed Oct. 11, 1906. Selects circuits for telephone systems by relays less in number than the total number of circuits, which relays are actuated by push buttons. Thirty circuits are divided into three groups of ten each, normally disconnected. Each group is controlled by a relay.

939,188. METHOD OF SELECTION IN SYSTEMS OF COMMUNICATION; E. E. Clement, Washington, D. C. App. filed Oct. 11, 1909. Segregates successive groups of circuits by means of relays which are selected in proper combinations by switches controlled by keys or push buttons.

13,035. (Reissue) TELEPHONE TRANSMITTER; W. W. Dean, Elyria, Ohio. App. filed May 17, 1909. Has a vibrating diaphragm with an independently supported cup containing granular carbon, an electrode supported by the cup, springs pressing the cup against the diaphragm and a second independent rigid electrode, the carbon granules lying between the electrode.